# UNION OF BURMA

# REPORT ON GEOLOGICAL SURVEY OF THE MONYWA AREA

## PHASE II

## (VOL. II)

October 1974

METAL MINING AGENCY
JAPAN INTERNATIONAL COOPERATION AGENCY
GOVERNMENT OF JAPAN

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# PREFACE

The Government of Japan, in response to the request of the Government of the Socialist Republic of the Union of Burma decided to conduct to a geological survey for mineral exprolation in Monywa area of Burma and commissioned its implementation to the Overseas Technical Cooperation Agency, which was integrated into the Japan International Cooperation Agency, newly established on August 1, 1974.

The Agency, taking into consideration of the importance of technical nature of the survey work, in turn, sought the Metal Mining Agency for its cooperation of accomplish the task within a period of three years (1972 - 1974).

This year was the second phase, and as for this current year, a survey team was formed consisting of nineteen (19) members headed by Dr. Tatsuzo Iwafune, Mitsui Kinzoku Engineering Service Co., Ltd., and sent to Burma on November 21, 1973. The team stayed there for a hundred and fifty-five (155) days from November 21, 1973 to April 24, 1974. During the period of its stay, the team, in close collaboration with the Government of Burma and its various authorities, was able to complete survey works on schedule.

This report submitted hereby summarizes the results of the survey performed for the second phase survey, and it will be formed a portion of the final report that will be prepared with regard to the results obtained in 1972 and 1974.

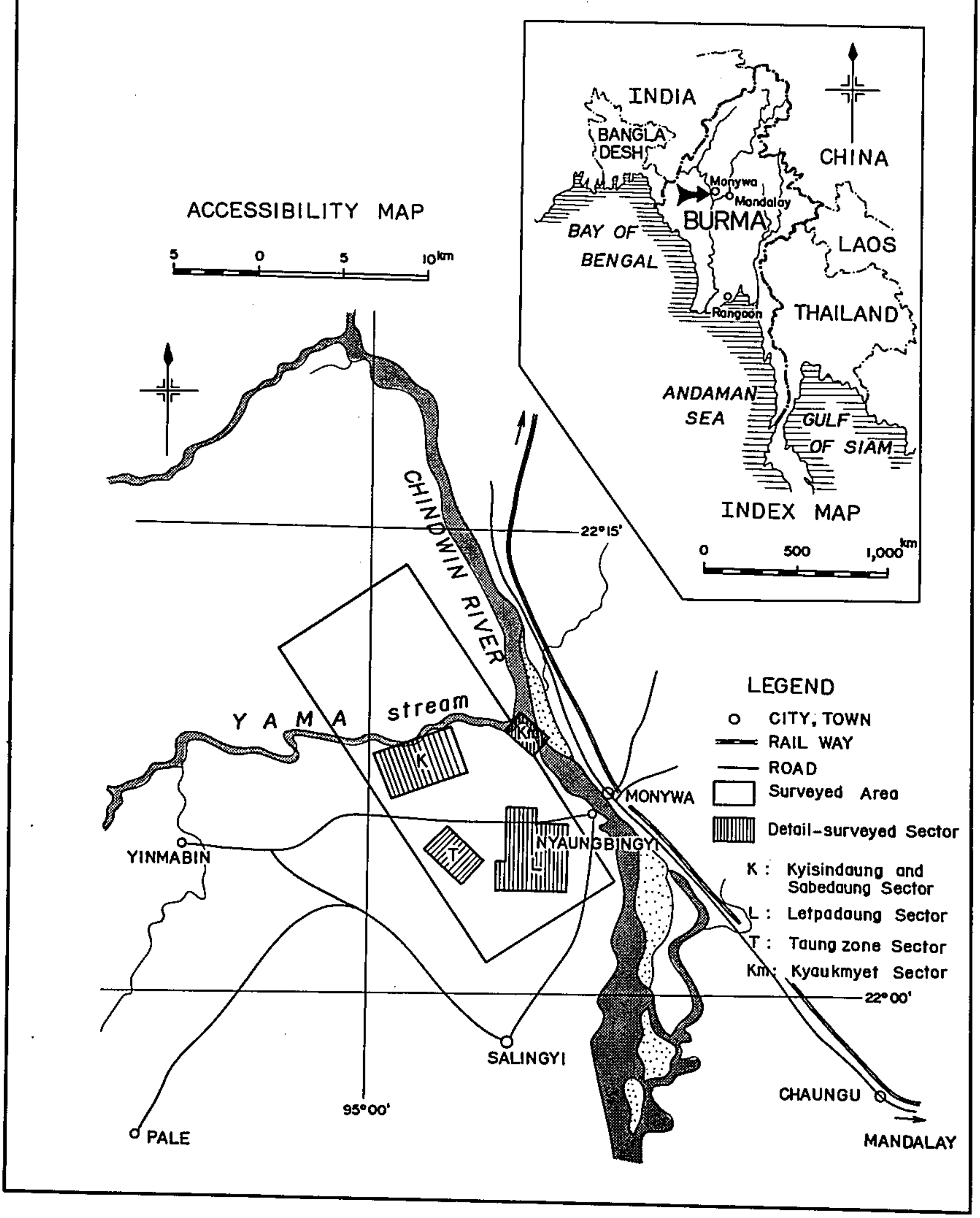
I wish to take this opportunity to express my heartfelt gratitude to the Government of Burma and the other authorities concerned for their kind cooperation and support extended the Japanese survey team.

October, 1974

SHINSAKU HOGEN
President
Japan International Cooperation Agency

Fig. 1

LOCATION MAP OF THE SURVEYED AREA



## General Contents

# ABSTRACT

The surface geological survey was concentrated in the detailed survey of such important areas of known ore deposits as Sabedaung, Kyisindaung and Letpadaung, and of the two other areas of Taungzone and Kyaukmyet, where it was thought further explolation would be warranted.

The geophysical survey by IP method was completed in the area including the Letpadaung ore deposit, the area corresponding to the southern half of the initially schemed area in the Phase-I survey, and with this completion the whole program of the IP survey was accomplished in the potential areas for which the IP survey was felt important.

The results, however, together with that of the detailed geological survey, have led to the negative conclusion regarding to the possibilities of finding any other ore emplacement except in the said three areas of known ore deposits.

Meanwhile, the precise investigation of the known ore deposits has made it clear that the mineralization is related to a series of volcanic activities of late Tertiary period represented by the domes of biotite porphyry and the groups of rhyolite dykes mostly penetrating the domes, and that the ore forming fluids were dispersed from the dykes and spread mostly in the domes in the forms of network stringers or disseminations.

It is also understood that the locations where mineralization is concentrated correspond to the intersections of two systems of fissures having the trendings of NE-SW and NW-SE.

The zoning of rock alteration related to the mineralization was carefully mapped out in the said three areas, and those zones of silicification, alunitization and argillization were identified to exist directly over the ore deposit, being overlapped one another, with the last zone having tendency to spread a little wider than the orebody.

Especially in the northern part of the Letpadaung dome, the portion where the frequent intrusion of rhyolite dykes were recognized distinctly in the alteration zone overlapped, displayed a clear conformity to the anomaly zone indicated by the IP survey, by which such investigation of alteration zones was proved very effective in combination with the IP survey for this type of ore deposits, and thus the method of preliminary exploration may be said to have been well established.

Eighteen holes were drilled as the drilling works in this phase of the program, and twelve of them were allocated to Sabedaung. Through this work, not only the ample informations were obtained about the subterranean geological features of ore deposits, but also the fundamental data necessary for the development of the deposits were collected, as for the thickness of leached zone, the thickness of minable ore zone, kinds and modes of occurrences of the principal copper minerals, etc.

The cores of the 12 holes drilled in the present survey were analysed independently at the laboratories in Burma and in Japan. From the statistical comparison of assay results by the two laboratories, it has been clarified that the deviation of the assay values between them was negligibly small within the range of the assay values between 0.3% Cu and 1.9% Cu, and resultantly, the entire Burmese data on the assay values had become available without any modification to facilitate the calculation of ore reserves and assays of the Sabedaung and Kyisindaung ore deposits.

Of the rest six holes, three were drilled at the southern foot of the Kyisindaung Hill, by which the southern extension of the said deposit was confirmed. Another hole encountered a part of a satellitic ore body found in the south of the Sabedaung ore deposit.

Through the observation of the cores of the drill holes in Sabedaung area, it was found that the copper mineral is essentially secondary chalcocite, but that chalcopyrite as the primary mineral was scarcely present. It shows that the ore zone estimated minable from the assay distribution of the drill holes corresponds to the secondary enrichment zone by such chalcocite.

Chalcocite generally occurs in fine grained form as minute as 40 to 100 microns, replacing parts of pyrite, as coating films, interfilling minute cracks in the crystal grains or interspaces of the grains, which necessitates regrinding in the mineral processing operation. As the ore contains acid soluble copper of about 15% of total copper content, it is handicapped in the processing procedure for the recovery of copper not to be raised up compatible enough to the usual copper ore composed essentially of chalcopyrite.

Of the twelve drill holes allocated to Sabedaung, nine holes had well penetrated the main portion of the ore deposit, and the cores from these nines were split into halves. A half, weighing about two metric tons, was sent to Japan for the metallurgical tests.

After the painstaking and repeated tests, such performances have been obtained as about 20% Cu of copper concentrate with about 80% of copper recovery, which was considered to serve as a guide for the anticipated future operation and enabled to design a pilot plant of mineral processing with the capacity of 50 metric tons a day.

The current estimation of the ore reserves at the end of July, 1974, on the Sabedaung and Kyisindaung ore deposits are as follows:

| | Reserves M/T | % Cu |
|---|---|---|
| Sabedaung | 25,720,000 | 1.01 |
| Kyisindaung | 66,540,000 | 0.77 |
| Total | 92,260,000 | 0.84 |

As the exploration for the Kyisindaung ore deposit is currently underway by means of grid-patterned systematic drilling of 100m spacing by the Burmese authority, there may be enough possibility to increase the reserve of the said deposit. It may eventually become necessary to carry out the more closely-spaced drilling in some limited portions of the deposit such as the shallower portion of leached zone, or the portion where sizable higher grade ore is expected.

The Letpadaung deposit is left short of the informations by diamond drilling, and it is still immature to figurate its ore reserve. But as the anticipated size of the mineralized zone may be big enough to compete with the Kyisindaung ore deposit, considerable increase of ore reserve will be expected if the possible ore zone will be ascertained by the future prospecting works. In this sense, it may be advisable to drill a few holes as soon as possible within the area of IP anomaly zone detected through the present survey.

In view of its big ore reserves of nearly 100 million tons, even as the total of only two of the known three deposits, and its availability of applying open mining, it is believed that the activities should be continued hereafter too, as for various kinds of technical investigations, test works and researches, as the project is considered possible to be brought into a big producing mine by low-grade but large-scaled operation if only the economical feasibility approves.

Especially it is necessary to carry out metallurgical tests by the pilot plant carefully and adequately so that the test results will contribute to the lay out of the main processing plant for the real operation.

Meanwhile, it is believed that now is the time for the project when the various ways of investigations and studies should be taken promptly in order to justify the economical feasibility.

# GENERALS

GENERALS

# CHAPTER 1 INTRODUCTION

## 1-1 Purpose of Surveys

The present surveys were carried out as the works of the second year phase of the Monywa Project in the Union of Burma. The works consisted of the surface geological survey, geophysical survey by IP method, and diamond drillings, and were conducted mostly in these areas of Sabedaung, Kyisindaung, Letpadaung, and others, which were extracted through the survey of last year phase as the areas of high potentiality of the mineral resources. The works were for the purpose to serve for the development of the Monywa Project into a copper mine.

## 1-2 Outline of Surveys

### 1-2-1 Areas Surveyed (cf. Fig. 1)

1) Geological Survey

Four specific areas within the Monywa Area of about 200 sq. kms. in all were chosen for the geological survey as follows;

Sabedaung--Kyisindaung (15 sq. kms.),

Letpadaung (15 sq. kms.),

Taungzone (3 sq. kms.), and

Kyaukmyet (1 sq. km.).

2) Geophysical Survey

An area of about 30 sq. kms. were covered by IP survey, involving Letpadaung and occupying the southern section of the Monywa Area.

3) Diamond Drillings

Drilling works were carried out in and around the Sabedaung ore deposit, on the southern foot of the Kyisindaung Hill, and in Kyaukmyet and the south of Sabedaung where the IP anomalies had been detected through the geophysical survey of the Phase-I.

1-2-2 Methods and Periods of Surveys

1) Geological Survey

The precise geological survey was carried out in each of the specific areas afore-mentioned by the geological sketching in a scale of 1/2,000 or 1/5,000 by using pocket compass and measuring tapes, and the core loggings were also done on the cores of the previous drillings done by the Burmese authority and on the recent cores obtained through the drillings by Japan.

The field works required 156 days from May 21, 1973 to April 25, 1974.

2) Geophysical Survey

The total line length of 97.2 kms. were measured by IP survey with the measuring stations at 100 meters interval, and the measuring lines were set at the spacings of 600 meters on the flat land and 300 meters around the Letpadaung Hill.

It took 108 days from November,21, 1973 to March 7, 1974 for the field works.

3) Diamond Drillings

The drilling works were performed as follows;

8 holes in the central part of the Sabedaung ore deposit with 1,207.2

meters of the total length drilled,

4 holes in the outskirts of the said deposit with 605.1 meters of the total length drilled,

3 holes on the southern foot of the Kyisindaung Hill with 904.3 meters of the total length drilled,

1 hole for the Kyaukmyet anomaly with the drilled length of 201.2 meters, and

2 holes for the South Sabedaung anomaly with the drilled length of 401.6 meters,

in which the overall length drilled amounted to 3,319.14 meters with 18 holes in all.

The field works took 171 days from October 21, 1973 to April 9, 1974.

4) Metallurgical Tests

The cores from the drilling of the Phase-II on the Sabedaung ore deposits, weighing about two metric tons, were sent by air to Japan, for which a series of the metallurgical tests were carried out by making use of the facilities of the Central Laboratory of Mitsui Mining and Smelting Company.

5) Data Analysis

Various data obtained through the field investigations were subjected for the complehensive data analysis such as geological structure, alter ations, grades of ores, which enabled the computation of ore reserves of the Sabedaung and Kyisindaung ore deposits.

Eight months were consumed for such works as analysis, interpretation, and readjustment of the data.

1-3 Organization of the Survey Team

The field works and the data analysis have been done by Mitsui Kinzoku Engineering Service Company in the co-operation of M. M. D. C. (Myanma Mineral Development Corporation) and D. G. S. E. (Directorate of Geological Survey and Exploration) which belong to the Ministry of Mines, Union of Burma.

The field survey team was so organized as follows;

1) General and Coordination Leader

| | |
|---|---|
| Tatsuzo Iwafune | Mitsui Kinzoku Engineering Service Co., Ltd. (MESCO) |
| Jiro Obitsu | Japan International Cooperation Agency |
| Nobumasa Chiba | Metal Mining Agency of Japan |
| Kyoichi Koyama | " |
| U Kyaw Nyein | D G. S. E. |
| U Aung Kyaw Mya | " |
| U Than Maung II | M. M. D. C. |
| U Khin Maung Nyo | " |
| U Kyi | " |

2) Geology

| | |
|---|---|
| Sakiyuki Mononobe | MESCO |
| Kazuharu Umetsu | " |
| Tsutomu Otsubo | " |

| | |
|---|---|
| Morio Hashimoto | MESCO |
| U Ye Win | M.M D.C. |
| U Sein Taik | " |
| U Myint Thin (6) | " |
| U Ohn Myint | " |
| U Tun Aung Kyi | D.G.S.E. |
| U Nyo Myint | " |
| U Kyaw Lwin | " |
| U Thein Tun | " |
| U Soe Naung | " |
| U Maung Maung | " |
| U Arthur Pe | " |

3) Geophysics

| | |
|---|---|
| Juzo Inuzuka | MESCO |
| Nobuo Nagata | " |
| Hirotaka Higashi | " |
| Eiji Tanaka | " |
| U Minn Oo | D.G.S.E. |
| U Tin Htut | " |
| U Bo Pye | " |
| U Khin Maung Htay | " |
| U Soe Win | " |
| U Tun Kyaw | " |
| U Saw Tha Maung | " |

| | |
|---|---|
| U Taut Htut | D. G. S. E. |
| U Thein Tun | " |
| U Tin Hla | " |
| U Kan Tun | " |
| U Kyaw Han | " |
| U Yan Naing | " |
| U Shwe Thein | " |
| U Myint Nwe | " |

4) Drilling

| | |
|---|---|
| Toshiaki Hisamoto | MESCO |
| Shiro Nodera | " |
| Hiroshi Hatazawa | " |
| Isamu Furuya | " |
| Hiroshi Takahashi | " |
| Sechio Iwashita | " |
| Tsuyoshi Hatakeyama | " |
| U Ba Soe | M. M. D. C. |
| U Lun Maunk | " |
| U Kyin Ngwe | " |
| U Maung Tun | " |
| U Nyan Kyi | " |
| U Win Alling | " |
| U Kyaw Kyaw | " |
| U Hla Maung | " |

# CHAPTER 2 SUMMARY OF WORKS IN THE SECOND YEAR PHASE

The performance of the surveying works of the first year phase was, in a word, the establishment of general geology. During the said surveys, efforts were paid to clarify the geological orientation of formation of ore deposits, by identifying the succession, structure, and mechanism of sedimentation of a series of Tertiary formations covering the basement of the Cretaceous formations of Mesozoic Era on one hand, and on the other hand, by pointing out the close genetical relationship of the ore deposits to a series of dominant activities of acidic volcanic rocks in late Tertiary. It was also emphasized that the zonal distribution of altered zones related to the mineralization was important as a means of identification of the mineralized areas, and the geophysical survey by IP method was pointed out effective to supplement the field geological survey.

In the course of the present survey, the efforts were mostly concentrated in the geological clarification of the ore deposits upon the bases mentioned above. In other words, the present survey was aimed at the establishment of the geology of ore deposits and its contribution to the pratical needs.

## 2-1 Establishment of Exploration Methods

The representative ore deposits such as Sabedaung, Kyisindaung, and Letpadaung, are emplaced in biotite porphyry forming the bell-shaped hills in the Monywa flat land, which are considered lava domes formed by the porphyry.

The field geological survey has yielded such important results that the ore forming fluids were dispersed from the groups of rhyolite dykes penetrating the porphyry and spread as network stringers or disseminations, and that the arrangement of the dikes in the porphyry was a main control for the localization of ore deposits.

At the same time, the zonings of such alterations as silicification, alunitization, and argillization, as emphasized in the previous year phase, have been carefully mapped out in each of the areas of known ore deposits, and it was proved very effective for the identification of the mineralized areas.

Especially in the northern part of the Letpadaung dome, the portion where the frequent intrusion of rhyolite dykes were recognized in the porphyry, with distinct distribution of overlapped alteration zones, displayed a clear conformity to the anomaly zone indicated by the IP survey, and thus the method of preliminary exploration may be said to have been well established.

On the other hand, with the completion of the IP survey for this year phase, it has covered the whole area which the IP survey was felt important for and schemed to be surveyed since the previous year phase. But the survey could obtain no significant anomalies to suggest the existence of other ore deposits except three known deposits of Sabedaung, Kyisindaung, and Letpadaung. Similar negative conclusion was obtained in the areas of Taung zone and Kyaukmyet too, together with the results of precise geological survey, where importance had been felt somewhat for further prospectings. The vast flat land surrounded by these three hills were also concluded hopeless, but, on the contrary, it meant that this vast flat land could be utilized for all kinds of ground constructions necessary for the possible development of the mine without any precautions against the ore underground.

2-2 Significance of Altered Zones

As the lava domes have been exposed under the incessant weathering and subjected under the quick oxidation in the tropical climatic conditions, the principal sulphide minerals as chalcopyrite and pyrite have been leached out with the consequent migration of their components, which makes it impossible to observe them on the ground surface. Som spotty occurences of green copper minerals are only the indications of copper mineralization. And, as a part of such minerals must have been redeposited from the copper, once released and migrated from the primary sulphide minerals, these showings alone are not sufficient as a guide to indicate the subterranean existence of ore deposits and might, in some cases, mislead how to infer the possible location. On the contrary, as the silicified zone, as one of the alteration products, remains in situ resisting against the leaching process, and, more fortunately, as the spots of alunite after the plagioclase phenocrysts remain as they are, the tracing after the propagation of mineralization will be led much more reasonably and reliably. In this sense, the investigation of alteration zones is very important as well as practical for this type of ore deposits.

2-3 Significance of Sabedaung Drillings

The diamond drill holes made by the Burmese authority since 1955 amount as many as some scores above one hundred, and it can be said that they possess the enormous diagnostic data of subterranean geology and ore deposits. But the recoveries of their cores are generally as low as about 60% in the portions of ore, and some problems were felt about their reliability especially in adopting their assay data to the estimation of grades of copper. It was one of the reasons, as the drilling works of the Phase-II, twelve holes among the total of eighteen were allocated to Sabedaung, where the previous drillings had been done most densely, for the purpose to make use of the additional data to compare with the previous ones. Fortunately the work was completed without any serious trouble and with almost perfect recovery of cores as high as 97%, which made their assay values to be taken as perfect standard to compare with the Burmese ones in order to check their reliability in terms of assay data.

In the development and operation of this type of ore deposits fitted for the low-grade but large-scaled system of operation, the practical range of assay variation often to be in question is considered from 0.3% Cu to 1.9% Cu. In the statistical comparison between the Burmese and additional data recently obtained showed very little deviation each other within the s said range. The availability of the enormous assay data by Burmese drillings were thus guaranteed, which contributed a great deal for the computation of ore reserves. The current ore reserves have been estimated only for the Sabedaung and Kyisindaung ore deposits, as they are more favoured with ample data, and in view of their proved accuracy, the work has been done entirely depending on the Burmese data without giving them any modification.

It is the matter of course that the Sabedaung drillings made it possible to investigate the subterranean geological features from the surface continuously downwards, which gave an ample geological informations in regards to the nature of mineralization. At the same time, they also made it possible not only to delineate clearly the strippable limit (leached zone) and minable ore zones for the provision of development, but also to extract some precausional points in regards to the mineral processing procedure, revealed through the studies of the behaviors of copper minerals by means of microscope and X-ray microanalyser with reference to the chemical analysis. The main points are summarized as follows;

(1) The principal copper mineral is essentially the secondary chalcocite, but chalcopyrite is very scarce as the primary mineral. It is almost proper that the delineated zone for the ore reserve computation (minable zone) is considered as the secondary enriched zone containing this sort of chalcocite.

(2) The granularity of the chalcocite is very minute. The copper contents leached out of the chalcopyrite under the supergene oxidation near the ground surface might have migrated underground probably in the form of sulphate and by encountering with the vastly distributed pyrite it has been reduced to recrystallize as chalcocite, resultantly their occurrences are such as coating films against the crystal of pyrite, filling up the minute cracks in pyrite, or filling the interstices between the crystals, of which grain sizes

vary from one micron to 150 microns, but mostly as minute as they come within the range of 10 to 40 microns.

(3) The ore usually contains about 15% of acid soluble copper against the total copper contents, which shows the oxidation process is still in progress, and the copper is put under the process from leaching to recrystallization.

As stated above the drilling works supplied many fundamental data related to the problems of development, of which significance should be highly evaluated.

## 2-4 Metallurgical Tests and Designing of Pilot Plant

As the nine holes among the twelve allocated to the Sabedaung ore deposit penetrated enough the principal portions of the deposits, the cores obtained from the said nine were split into two halves, and one half weighing about two metric tons, were forwarded to Japan for the metallurgical tests.

The ore can not be said of easier nature in view of the mineral processing, in comparison to the commoner copper ore of which principal copper mineral is chalcopyrite, as the points stated above will tell it fluently. The minuteness of the grains of ore minerals made it difficult for the isolation procedure which automatically necessitates the regrinding. In the results of flotation tests obtained from the resent test works, it says that the ore should be ground as minute as under 400 mesh.

Most of the copper content corresponding to the acid soluble copper will not be recovered by flotation process, resulting in the lowering of the total recovery of copper.

Through the painstaking and repeated tests, however, overcoming such handicaps of the ore characters, it has come to obtain the results as about 20% Cu in concentrate with about 80% of recovery, which will serve as a guide for the anticipated operation in the future.

It is quite obvious that once this project will be brought into development someday in the future, the system of low-grade but large-scaled operation will be adopted, and the economical amount of ore to be treated will amount at least as much as several thousand tons a day. In comparison to the supporsedly large processing plant to be required, the amount of only two tons of ore subjected to the metallurgical tests was too small for this purpose, but only made it possible to grasp the principal procedure of the system to be considered.

Moreover, as the samples are from the drill core having some difference from the natural state of ore actually mined from the ground, the metallurgical tests should be continued in somewhat enlarged scale, and it is also desirable to supply the ore by digging a part of the ore deposits, in order to contribute to layout the principal plant for the future operation. In view of this, a trial design of the pilot plant with the capacity of 50 metric tons a day was made based upon the results of the metallurgical tests.

As the Burmese authority looks to expect the quick commencement of the tests by this pilot plant as the work programme of the Phase-III and thereafter, the case may happen when the design will not be applied as it is, in order to meet with the desire under such the resstricted time allowances.

# CHAPTER 3 CONCLUSIONS AND FUTURE ASPECTS

## 3-1 Potentiality and Exploration

Through the present investigation, it was made possible to try the computation of ore reserves on the Sabedaung and Kyisindaung ore deposits, of which results are shown as follows;

| | Classification | Reserves M/T | Cu % |
|---|---|---|---|
| Sabedaung | Possible ore with high accuracy | 25,720,000 | 1.01 |
| Kyisindaung | Possible ore with moderate accuracy | 66,540,000 | 0.77 |
| Total | | 92,260,000 | 0.84 |

The reserves of about 92 million tons will be increased as much as 100 million tons with good reason that the Kyisindaung deposit is still under exploration by the Burmese authority. Although it is still immature to figurate the reserves of the Letpadaung ore deposit, it is considered compatible with Kyisindaung judging from the scale of indications surveyed, and such may serve to expect the possible duplication of the present reserves, depending upon the results to come out of the future prospecting. And the results will affect very much to perform the future visions of this project.

The precisity of the exploration is different in the three areas as follows;

(1) Sabedaung .......... Can be said to have completed the exploration.

To be given the first priority to be developed in the Monywa project.

More investigations regarding the development should be made.

(2) Kyisindaung ........ The systematic drilling in the pattern of 100 meters spacing will soon come to completion by the Burmese authority. It is located in the nearest to be approached from the Sabedaung deposit, and is to be taken as the important ore source in case of the possible increase of production eventually to come after the commencement of operation. It may be worth-while to study provisionally whether the local exploration in the closer spacing would be necessary for the partial problems such as the thinner overburden or some portions whether the sizable ore of higher grade would be expected.

(3) Letpadaung ......... More than twenty drill holes have been made in this area and have encountered the ore existence. But as they are mostly located at the foot of the hill which corresponds more or less to the periphery of the anomaly zone obtained through the present survey, and almost none of the drilling has ever been done within the anomaly zone, it is impossible to affirm the real geological features of this deposit. Therefore it is advisable to explore the principal portion of this anomaly zone with a few diamond drillings. This preliminary exploration will be desirable to be carried out as soon as possible in view of getting an idea of potentiality.

## 3-2 On Feasibility Studies

The three ore deposits above-mentioned are all possible to be operated mainly by open mining, and if only their economical feasibility is justified, this project has much opportunity to become a big mine of low-grade but large-scaled operation system. Some of the fundamental data necessary for the determination of the development system have been obtained through the present survey. The project is now on the stage to advance the progressive activities such as the more detailed investigations, researches, and a series of test works, and it is believed the project has begun the first step already.

It is believed very timely attempt to commence the metallurgical tests in more expanded scale, to investigate the practical and adequate system of the processing, in overcoming the fatal handicaps of the nature of ore, by which results the lay-out of the main processing plant of the future operation will be reasonably drawn out.

On the other hand, there has been recognized none of the sign to deny the development, but the results to support the progressive attempts to be taken in regards to the development. Therefore, the efforts should be focussed to justify the economical feasibility by pursuing the possibilities more in details.

# PART I GEOLOGICAL SURVEY

## PART I GEOLOGICAL SURVEY

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# PART I GEOLOGICAL SURVEY

## CHAPTER 1 OUTLINE OF THE SURVEY WORKS

The present geological survey was performed for the purpose as follows;

(1) To comprehend firmly the geological situation of the mineralization by carrying out the detailed geological survey in the favorable areas selected from the results of the previous year's survey, for the programming of the further exploration works in the Monywa area.

(2). To make clear the conditions for the emplacement of the known ore deposits such as Sabedaung and Kyisindaung and to estimate their ore reserves, for the possible future development of the mines.

The actual works carried out for the above purpose were as follows;

(a) Detailed geological survey in the five potential areas of Sabedaung Kyisindaung, Letpadaung, Taung-zone and Kyaukmyet (total area of 34.5 $km^2$).

(b) Core logging of the drill holes, with the total length of about 11,000 meters.

### 1-1 Detailed Geological Survey

1) Detailed geological survey was carried out on the topographical maps prepared by the survey team itself in the following scales;

| | |
|---|---|
| Sabedaung | 1 to 1,000 |
| Kyisindaung, Taungzone, Kyaukmyet | 1 to 2,000 |
| Letpadaung | 1 to 5,000 |

2) The old workings and the trenches cut in the main parts of the area were mapped in a scale of 1 to 300.

1-2 Logging of the Drill-cores

1) Cores were logged in a scale of 1 to 300, for the following drill holes.

18 holes drilled by the present Japanese survey team, totalling 3,319.4 meters.

41 holes drilled in the Sabedaung area by MMDC, totalling 7,632.8 meters.

2) Of the 18 holes drilled by the Japanese survey team, twelve (12) were for the Sabedaung ore deposit. The splitted halves of the cores, collected from the 9 of the above 12 holes, totalling 1,359 meters, were forwarded to Japan for the mineral processing test.

3) The detailed examination was completed on the drill cores of the holes in Kyisindaung and Letpadaung, for the geological interpretation of the ore deposit in each area.

1-3 Investigation Carried Out

1) To accomplish the purpose of the present survey,

* Petrography and distribution of the igneous and sedimentary rocks were investigated in detail, to make clear the relation among them.

* Study for the characteristics and the location of the fissures, dykes and fractured zones was also performed for the interpretation of the geological structure.
* Rock alteration was checked as well, to confirm its relation to the mineralization.

2) From the results of the above-mentioned detailed geological works, it was suggested that the investigation of rock alteration was most useful for the geological study of the ore deposits. As the degree of the alteration was believed to be successfully classified, special survey for the rock alteration was carried out in the said five favorable areas. More than 1,400 samples collected on the surface and over 400 samples taken from the drill cores were examined on the sections made by the diamond rock-cutter. The zoning of the rock alteration was well established, sufficient to elucidate the relation between the alteration of the country rocks and the mineralization, which was very effective for the comprehension of the forms of the known mineral deposits, and for the programming of further exploration.

1-4 Laboratory and Desk Works

1) Thin sections of the typical rock samples were prepared to check the field petrography and the rock alteration, microscopically.

2) Polished pieces of the typical core samples collected from the logged drill holes in and around the Sabedaung ore deposit were examined as for the composition and the paragenesis of the ore minerals under microscope.

Ore minerals were also identified by X-ray refraction or by X-ray micro-analyser.

3) Two tons of core samples sent to Japan were forwarded to the laboratory for the assay of total copper content in every 2 meters of the cores, and for the analysis of soluble copper as well as As, Zn, Au, and Ag contained in the cores every 6 to 10 meters.

The drill cores in the IP anomalies were analysed only for Cu, Fe and S, every 30 meters. (The chemical analysis was entrusted to the Central Laboratory of the Mitsui Mining and Smelting Co., Ltd.)

4) Estimation of the Ore Reserves as for the Sabedaung and the Kyisindaung Ore Deposits.

(1) Assay data of the MMDC drill cores were collected during the present survey, and the correlation of the chemical assay results by Burmese laboratory to those by Japanese was studied carefully.

(2) Ore reserves of the Sabedaung and the Kyisindaung ore deposits were estimated by scaled cross sectional method.

5) Geological cross-sections were drawn for the detailed study of the geology in each area surveyed.

Also, geological maps were compiled in the scales of 1 to 10,000 and 1 to 5,000 for the further careful consideration of the project. (Further reference should be made to the Report on Geological Survey of the Monywa Area Phase I (Vol. 1) September, 1973. on general geology.)

# CHAPTER 2 OUTLINE OF THE GEOLOGY

## 2-1 Stratigraphy

According to the regional geological survey of the PHASE-I, the Monywa area is underlain by the sequences of Cretaceous, Tertiary and Quaternary. The results of the Survey are summarized below.

### 2-1-1 Basement Rocks

The basement of the Monywa area is composed of green rocks, represented by diabases and altered porphyrites, correlated to upper Cretaceous, and hornblende-quartz diorites intruding them, in addition to granophyre dykes cutting all of the above rocks. The basement rocks are developed well in the area 5 to 7 km west of Kyisindaung, but the thickness of the basement is unknown.

### 2-1-2 Tertiary System

The Tertiary system in this area is divided into two formations. The lower is Damapala Formation, correlated to Pegu Group regionally, while the upper has been named Magyigon Formation, in regional correlation to Irrawaddy Formation.

1) Damapala Formation

The period of sedimentation of the Damapala Formation is thought from Oligocene to Miocene. Overlying the basement rocks, Damapala Formation comprises mostly volcanic pyroclastic rocks originated from the andesitic volcanic activity with the well-stratified sandstone in its uppermost part. Total thickness of the Formation is over 300 meters, but the bottom of it has not been confirmed yet.

2) Magyigon Formation

The beds of Damapala Formation are conformably overlain by the rocks of the Magyigon Formation, which are found broadly in the plain of the Monywa area. The Magyigon Formation is thought to have accumulated from Miocene to Pliocene and the thickness of it is approximately 800 meters.

Magyigon Formation is composed of the repetition of the rocks derived from the volcanism mainly of hornblende-biotite porphyry and from the sedimentation. At the last stage of the accumulation of Magyigon Formation, volcanic activities culminated and lava domes of biotite porphyry were formed.

Subsequent to formation of the lava domes, rhyolite dykes were seen to have intruded the domes and their surroundings. The dykes have brought mineralization with them at Sabedaung, at Kyisindaung, at Letpadaung and so on.

Small hills of Shwebonthataung and Kyaukmyet were formed by the intrusion of rhyolite, with the preceding activities of tuff extrusion overlying sandstones and mudstones of the uppermost Magyigon Formation.

2-1-3 Quaternary

Diluvium and alluvium are found in the Monywa Basin, as Quaternary Sediments.

1) Diluvial Sediments

Covering uncomformably the basement and all the Tertiary formations, Quaternary diluvial sediments, named Kangon Formation are widely distributed in the plain of the Monywa area. They are composed pebbly sands and muds, 30 to 50 meters thick, and are consolidated only to a certain low degree.

2) Aluvium

As the recent sediments, three levels of river terraces composed of red sandy soil are observed within about 20 meters above the river floor of the Chindwin River and of the Yama Stream.

Also, overlying the Kangon Formation, there is a recent volcano of olivine basalt, which forms a lava plateau of approximately 2 km in diameter, located about 8 km north-west of Kyisindaung. Olivine basalt is also seen in a depressive zone of the plain between the southern part of Kyisindaung swell and a hill to the south of Kyadwindaung, in the form of two parallel dykes, 1 or 2 meters wide.

## 2-2 Volcanic Rocks and Geological Structure

### 2-2-1 General

From the results of the Phase-I Survey, it has been concluded that the Monywa area comprises a local geological basin formed along the eastern margin of the Salingyi Uplift, which develops widely in the central part of the vast Burma Plain, and that the formation of this geological basin was due to faulting movement of NE-SW trending, accompanied by intense volcanic activities in the process of the subsidence of the basin. The evidences of the volcanic activities are best exposed in the area of

225 $km^2$, 15 km in E-W and 15 km in N-S, to the west of the Chidwin River.

2-2-2 Subsidence of the Basin and the Sedimentation

1) By the results of the Phase-I Survey, the Monywa Basin accompanies Silaung Basement ot its north, and Salingyi Complex to its south.

The basement rocks are exposed in the areas to the north-west and to the west of the Monywa Basin. That is, the Tertiary system is distributed in the neighbouring areas north-east of the basement.

Several faults of NE-SW trending and gentle foldings with E-W axes are recognized in the Tertiary system of this area. The former is considered to have participated to the subsidence of the Monywa Basin.

2) The subsidence of Monywa Basin started in Oligocene, with the sedimentation of Damapala Formation overlying unconformably the basement rocks, followed by the culmination of the subsiding activity in Miocene to Pliocene, when Magyigon Formation accumulated over 800m in thickness. The sinking of the Basin went on, though fading away gradually, up to the deposition of Kangon Formation in Diluvial Epoch. The thickness of each formation of Tertiary and Quaternary accumulated in the Monywa Basin is given here;

| | |
|---|---|
| Damapala Formation | over 300m |
| Magyigon Formation | about 800m |
| Kangon Formation | 50m |
| Total | over 1150m |

3) To mention about the structure of NE-SW trending in Monywa Basin, the following facts have been observed.

(a) There are many faults and dykes of this trending.

(b) Damapala and Magyigon Formations are bounded by faults and dykes of this trending.

(c) Axes of the foldings observed in the above two formations are cut by them as well.

From those facts it has been confirmed that the dominant structure developed in the Monywa Basin is that of NE-SW trending. Also, it has been concluded that the structural linears of this NE-SW trending took significant role in the formation of the basin, judging from the extensive distribution of Tertiary sequences in the north-eastern part of the subject area, as well as of the tongue-shape development of diluvial sediments projected to the west in the central part of the basin. They are thought to have following characters.

(a) These structural linears compose step faults from the NW and SE margins toward the bottom of the basin.

(b) The faults of this trending are "syndepositional faults", to have kept moving while the sediments were accumulated.

(c) The structure of this NE-SW trending controlled the volcanic activities.

(d) The faulting movement started at the same time of the beginning of the folding movement in the Damapala and Magyigon Formations.

It was emphasized, in the geological report of the Phase I, that the NE-SW structure has wide ranges of influence on the form of sedimentation in this basin.

2-2-3 Fault System and Volcanic Rocks

1) From the above results of the Phase-I Survey, the following five areas were picked out as the favorable areas warranting further detailed investigation;

(a) As the known mineralized areas

1. Sabedaung
2. Kyisindaung
3. Letpadaung

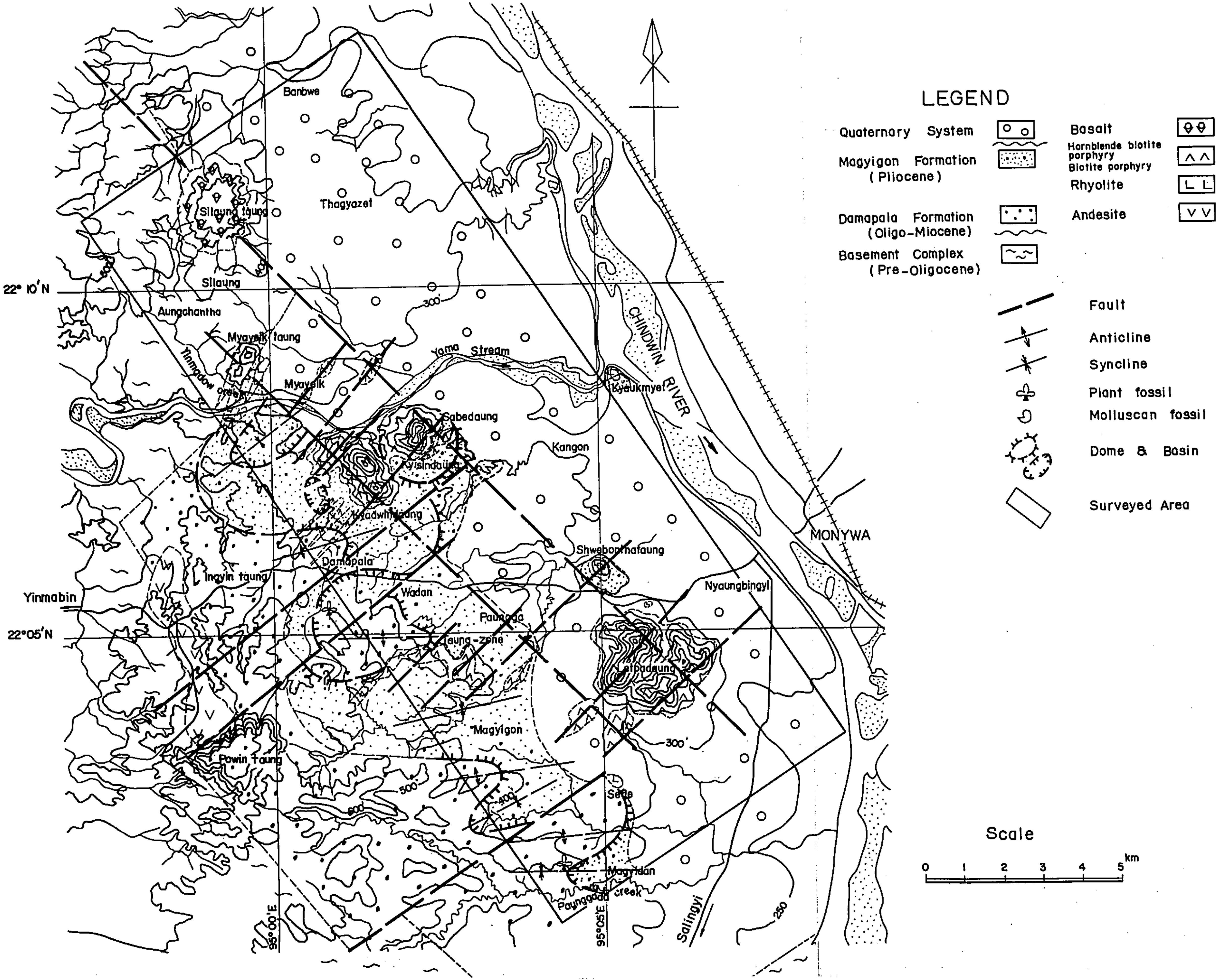
(b) As the indicated potential areas

4. Taungzone
5. Kyaukmyet

Special attention was given to the trendings of the dykes in these five areas, and it was confirmed that, in addition to the dykes of NE-SW trending, there are many dykes controlled by another dominant linear NW-SE, which was thought to have intruded at the last stage of the accumulation of Magyigon Formation. It was observed that general trending of the intrusive bodies of rhyolite forming small hills at Kyaukmyet and at Shwebonthaung, is also NW-SE.

2) From the above-mentioned observation that there are numerous dykes and intrusives of NW-SE trending rectangular to the predominant NE-SW dykes, Fig. I-1 has been drawn, expressing an idea that the linears of NE-SW could well be extended and that the volcanic activities of Miocene and afterwards must have occurred at the structural cross-points of the linears of NE-SW and NW-SE. It seems that there were intense volcanic activities

# Fig I-1 GENERALIZED STRUCTURAL MAP OF MONYWA AREA



in certain areas with many such cross-points. These structural linears of the two trendings were thought to have been formed contemporaneously as shearing faults, with the compressive force of N-S. In short, the volcanic activities of Miocene to Pliocene were controlled by the structural linears of NE-SW and NW-SE. Furthermore, there is another fact, suggesting the NW-SE linear's control over recent volcanism with the NE-SW linear, that the structural position of the olivine basalt extrusion in the northwestern part of the Monywa Basin is on the northern extension of the line linking the two hills of Letpadaung and Kyishindaung in the central part of the Basin. It has been recognized that the extrusion of the olivine basalt was at the border of the basement and the Quaternary sediments.

2-2-4 Lava Dome

1) The most remarkable volcanism observed in this Monywa Basin is the one represented by the hornblende-biotite porphyries during the period of the accumulation of Magyigon Formation. Two stages of activities are recognized about this volcanism of hornblende-biotite porphyries. The evidences of the later stage extrusion are seen at the upper part of the Magyigon Formation, while the rocks belonging to the earlier stage are contained in the lower part of the Magyigon Formation. As a lava flow of maximum 250 m in thickness, the rocks of the earlier stage are found at Taunzone, accompanying some preceding tuffs. The activity of the lava-flow was followed by another effusion producing tuffs. Their extrusion is recognized to have been at the early stage of the accumulation of the Magyigon Formation. The lava-flow was intruded by the lenticular dykes

of biotite-quartz porphyries trending NE-SW and NW-SE.

2) The volcanic activity of the hornblende-biotite porphyries recognized in the upper part of the Magyigon Formation is found at Kyisindaung and at Letpedaung. The succession of the extruded rocks so far observed is in the order to tuff-lava-tuff, same as seen at Taungzone. The distribution of the materials resulted from the volcanism is as extensive as 5km x 5km (the area of about $25km^2$) in each case at Kyisindaung and at Letpadaung, which denotes that this volcanism was the most remarkable in the Monywa Basin.

3) The volcanic activity represented by the hornblende-biotite porphyry was followed by the lava domes formation of biotite-quartz porphyry almost free from hornblende, which can be observed at the volcanic hills at Kyisindaung and Letpadaung. It was confirmed in the present survey that the volcanic hills at Sabedaung, at Kyisindaung and at Letpadaung are lava domes of the biotite-quartz porphyries, from the following points;

(a) By the core-logging of the 54 drill holes in Sabedaung area, tuffs and sandstones belonging to the Magyigon Formation were found underneath the biotite-quartz porphyries forming Sabedaung hill.

(b) The drilling of the five holes carried out in the present survey at the southern foot of the Kyisindaung hill (two of the five by MMDC and the rest three by the Japanese team), revealed that there are tuffs, sandstones and mudstones beneath the Kyisindaung hill.

(c) In Letpadaung area as well, the three drill holes caught tuffs below the biotite-quartz porphyries composing the northwestern part of the Letpadaung hill.

There are two volcanic hills at Kyadwintaung to the southwest of Kyisindaung. Although the subterranean geology of the hills has not been known yet, it is thought that they are lava domes as well as bysmalith structures, trending NE-SW mainly, are recognized in the upper part of these two hills.

4) As stated above, the volcanism in the Monywa Basin was controlled by the structural linears trending NE-SW and NW-SE. It is considered that the center of the volcanism was translocated from Taungzone area to Kyisindaung and Letpadaung according to the period of the activities; from the earlier to the later stage of the accumulation of the Magyigon Formation.

The intrusion of numerous dykes of rhyolite followed the formation of the lava domes at Sabedaung, at Kyisindaung and at the northeastern part of Letpadaung, in the upper part of the Magyigon Formation. The dykes at Taungzone seem to have intruded at the same time.

It is considered that the mineralization took places at the end of the intense volcanic activities forming lava domes, viewing from the fact that the Monywa mineral deposits were related to the above-mentioned dykes.

## CHAPTER 3 OUTLINE OF THE ORE DEPOSITS

### 3-1 General

Monywa copper ore deposits are those which are related to and distributed at the volcanic hills scattered in the Monywa Basin. They are divided into three groups    Sabedaung, Kyisindaung and Letpadaung, all of which are epithermal copper deposits of the nature of network and dissemination related to the rhyolite dykes intruded in and around the lava domes of biotite porphyry formed through the Pliocene volcanism.

Ore minerals are chiefly pyrite and secondary chalcocite. The chalcocites were produced through the reaction in the meteoric water and distributed almost horizontally in a lenticular shape along the bottom of the oxidized and leached zone at the depth of 10 to 100 meters below surface.

### 3-2 Characteristics of the Ore Deposits

1) From the field observation and the logging of the cores in and around the known deposits of Sabedaung and Kyisindaung, it can be said that these deposits lie in the highly silicified, alunitized and pyritized zones with many rhyolite dykes in the lava dome, surrounded by the argillized zone composed chiefly of kaolin minerals. Though the rocks on the surface are thoroughly oxidized and leached, evidences of silicification and alunitization are usually well preserved and the pyrite concentration is represented as iron gossans, as the result of hematitization and limonitization.

2) The remarkable mineralization and alteration are usually recognized along the rhyolite dykes, which were introduced through the fissures trending NE-SW and rectangular NW-SE, developing in and around the lava domes. In the vicinity of the brecciated rhyolite dykes containing breccias of biotite porphyries, subordinate N-S or E-W fissures are well developed, accompanying network fissilities and small dykes of the brecciated rhyolite of the same trendings.

3) Usually, the dykes related to the mineralization are recognized to have intruded mainly into the lava domes in the Monywa area. However, in a small swell about 300 m southeast of the Sabedaung hill, silicification almost all over and boxworks of iron gossans are found, and alunites are also discernible. The swell is as high as about 10 m above the plain level, and as broad as 70,000 $m^2$, composed of sandstones belonging to the Magyigon Formation. The IP anomaly is coincident to the swell, too, with high FE values. Though no rhyolite dyke can be seen on the surface of the swell, the diamond drilling performed by MMDC in 1972 for an IP anomaly caught the rhyolite dykes intruded into the hornblende-biotite porphyry and the alternation of tuffs and sandstones, as well as the indication of mineralization. This indication is called "Sabedaung South" and diamond drillings are currently being carried out in the grid system by MMDC.

4) The area containing rhyolite related to the mineralization are Kyisindaung, Sabedaung South and the north-eastern part of Letpadaung. They are distributed in a fair alignment along a NW-SE line located in the central part of the Monywa Basin. It is naturally thought from the above fact that

this structural linear had continuous effect and control on the most remarkable volcanic activity in the Basin, up to the end of it, when mineralization emerged.

5) The richness of the mineralization is controlled by the density of the rhyolite intrusion. Network fissures are developed more abundantly in biotite porphyries and hornblende biotite porphyries than in such rocks as tuffs and shales, and rich mineralization is found chiefly in porphyritic rocks. Also, in the known ore deposits at Sabedaung and at Kyisindaung, mineralization is observed to fade out remarkably in the tuffs, sandstones and shales underneath the porphyritic rocks. Accordingly, the distribution of the orebodies is largely controlled by the forms of the lava domes. It is thought that the mineralization shows halo-like development along the surroundings of the rhyolite bodies, to render it seen radial around a dyke on the geological section. To sum up the above-mentioned geological data and assay results, it can be said that each of the secondary enrichment zones warranting exploration in Monywa area lies ovally with its long axis horizontal, as shown in the attached Fig. I-2.

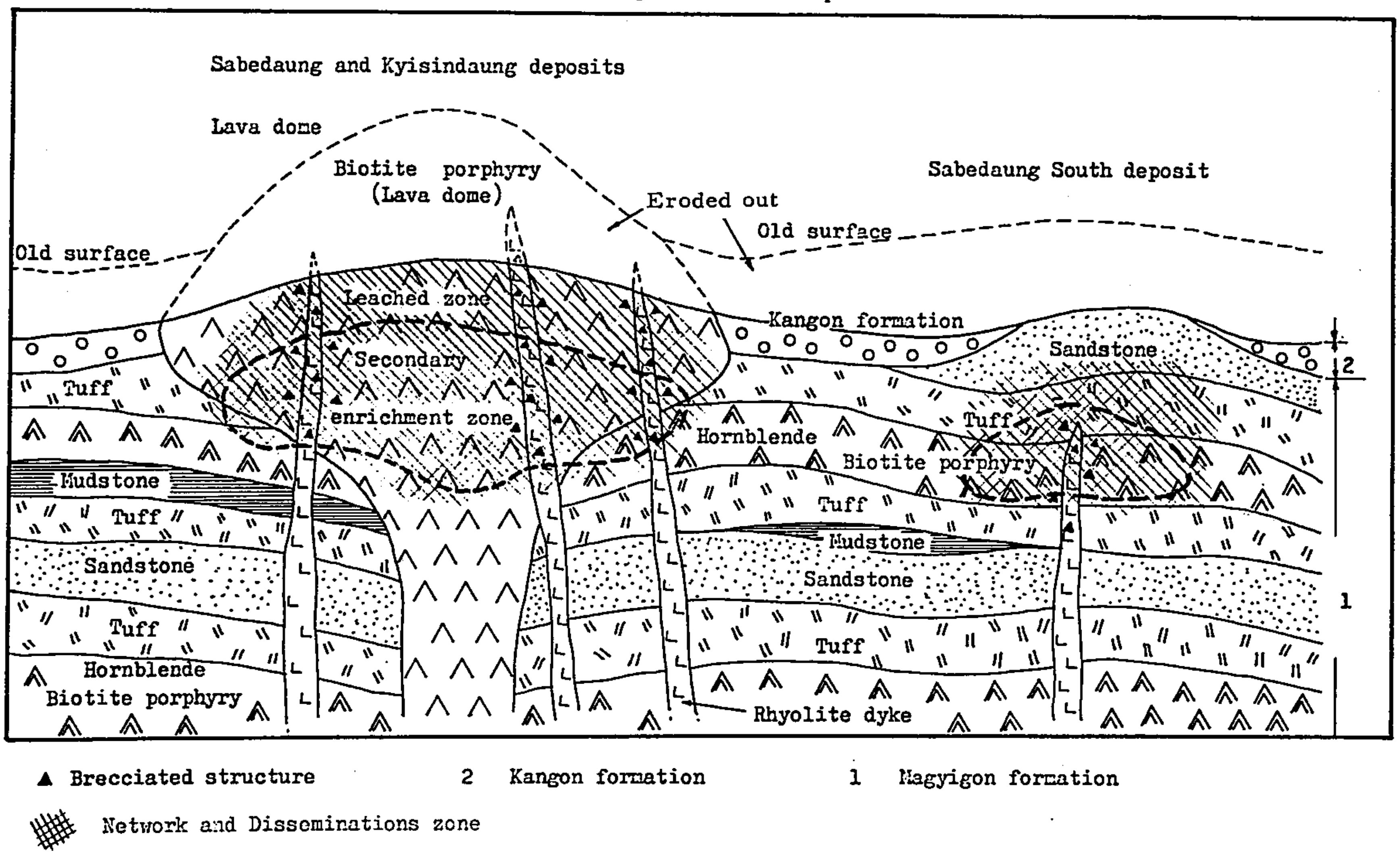
### 3-2-1 Minerals Composing Ore Deposits

Minerals composing Monywa ore deposits are as follows. They have been identified under microscope, by X-ray refraction and by X-ray micro-analyser.

(a) Ore minerals,

pyrite, chalcopyrite, secondary chalcocite, enargite, tetrahedrite, sphalerite, hematite and green copper-oxide minerals.

Fig. I-2 Schematic Explanation of Ore Deposits



(b) Gangue minerals,

quartz and calcite.

(c) Clay minerals,

kaolin, sericite (or a mica-clay mineral with a peak at 10 A in X-ray refraction) and alunite.

3-2-2 Occurrences of the Minerals

(1) Ore Minerals

1) The most abundant ore mineral present is pyrite. Especially, in the Sabedaung ore deposit, large part of the ore is composed of pyrite.

Main copper minerals are chalcocite. The composit ratio of pyrite to chalcocite is 10 to 1, by the calculation based on the assay results of the core samples collected from the 9 holes drilled in the Sabedaung ore deposit by the Japanese survey team in 1973.

2) Scarcely are there other copper minerals. Chalcopyrite is found only rarely, as a very small inclusions of approximately 50 microns, sitting in the grains of pyrite under microscope. It is thought that most of the chalcopyrites were changed to secondary chalcocite.

3) Composition of the ore minerals

a) The grain size of pyrite ranges from under 1 micron to 5 mm, but most of it is fine-grained, 0.1 mm to 1 mm. Generally, the form of pyrite is irregular, and the following structures are observed; Corrosion structure, brecciated structure, aggregate of fine grain pyrite, fine networks in various crystals. The occurrence of pyrite is regarded mostly as fine networks and dissemination, both seen in silicified zones. In the primary ore zone of Sabedaung ore deposit, pyrite is observed microscopically to accompany fine-grained chalcopyrite of 3 to 5 microns irregular in form, by the examination of the polished section of a drill-core sample. In case pyritization is observed in argillized zone, though weak usually, pyrite forms euhedral crystal of the size of 1 to 2 mm, generally. In silicified zones, numerous network-fissilities are extensively developed without any particular trending which could have been favorable passages for leached copper ingredient to form secondary enrichment zone. The weight percentage of pyrite is 9.5% calculated on the basis of the assay results (for Cu, Fe and S) of the ore samples, collected from the cores of the 9 holes drilled in the Sabedaung ore deposit. (The samples had been forwarded to Japan for mineral processing test.)

It was confirmed when the drill cores were examined that the ore deposits of Kyisindaung and Letpadaung are as rich in pyrite as that of Sabedaung. It is considered to be appropriate that IP method was applied in this Monywa area for the exploration of minerals because the mineralization is composed largely of pyrite, which has fairly strong polarization effect, electrically.

b) Chalcocite is observed to be present in the ore in various occurrences as given below;

   * to fill up small cracks in pyrite.

* to concentrate as the corrosion and replacement products after pyrite, mainly along its crushed faces where pyrites are broken.
* to replace thin pyrite veinlets.
* to concentrate as fine grains 1 to 3 microns in the middle part of pyrite vein showing comb-structure.
* to disseminate in the silicified country rocks.
* to appear as very thin seams in quartz veinlet.

c) Black prismatic crystals of enargite, 1.5 to 2 mm in diameter and 5 mm long, are visible in pyrite veins, between 259 m and 275 m of the drill cores of the hole 13E, in the Kyisindaung ore deposit. However, no enargite was discernible under microscope and by X-ray refraction in the polished sections prepared from the cores of the 9 holes drilled in Sabedaung by the Japanese survey team in this year, and also in those prepared for the preliminary study for the mineral processing test.

In the cores of the drill holes No. 33 (114.5 m), No. 30Q (65.2 m), granular enargite in pyrite grains were recognized by the microscopic examination of the polished sections.

d) The report of the Phase-I Survey describes the following.

No tetrahedrite was observed in Sabedaung ore deposit. But, in the polished section of the core sample collected at 400 m of the drill hole K 13 G, in Kyisindaung, fine graines tetrahedrite was recognized in association with tennantite in chalcopyrite grain.

Generally, enargite, tetrahedrite and tennantite occur very rarely.

e) Rarely sphalerite is discernible microscopically as irregular small grains, 10 to 60 microns, in quartz veinlets.

f) Hematite is present as secondary product changed from pyrite, and occurrs as dissemination or fine veinlets in oxidized and leached zone.

4) The contents of the four elements, zinc, arsenic, gold and silver were analysed chemically, of the samples collected every 6 to 10 meters from the 12 holes totalling 1,538 meters, drilled by the Japanese has shown the following assay results;

| | | |
|---|---|---|
| Zn | < | 0.01 % |
| As | < | 0.01 % |
| Au | < | 0.1 g/t |
| Ag | < | 1 g/t |

Thus, it has been concluded that the copper ore in the Monywa ore deposits could be treated singularly as chalcocite ore. Very little amount of lead (Pb), antimony (Sb), bismuth (Bi), nickel (Ni), molybdenum ($MoS_2$) and mercury (Hg) was detected. The concentrate of 20.1% of copper content, after floation of the feed of the 0.89% Cu crude ore (Concentrating ratio is about 23 times), was analysed and the following results were obtained;

| | | | |
|---|---|---|---|
| Pb | 0.01 % | Ni | 0.02 % |
| Sb | 0.04 % | $MoS_2$ | <0.01 % |
| Bi | 0.01 % | Hg | 0.2 ppm |

5) The assay results of 769 samples, each of which is composed of 2 meters of core collected from the 12 holes totalling 1,538 meters, drilled in the Sabedaung area by the Japanese survey team in 1973, revealed average copper content of 0.69%. Another assay of 292 samples taken at every 6 to 10 meters of the cores from the above-mentioned holes, has shown the acid soluble copper content to be 0.11%, which leads to the idea that 16% of the total copper contained in the ore is soluble in acid solution. It has been confirmed that chalcocite is extraordinarily unstable. Left even in the atomosphere of laboratory, chalcocite on the surface of polished section changes easily to powderly new products of chalcocite in a few days. It would be necessary to give careful consideration to such a mineralogical feature as this, for the possible development of the mine.

6) Oxide copper minerals are malachite, azurite, boothite and pisanite, which were present in the oxidized and leached zone as well as in the secondary enrichment zone. They occur as dissemination or fine veinlets, and concentrate in zones of 5 to 30 cm in thickness. But they occur so rarely as to be recognized only in a few of over 60 holes drilled in the Sabedaung sector. In the field, in most cases, they are found to be present along the foot of lava domes. The top parts of the lava domes scarcely carry them. The exploration carried out in 1930s and in the age of the Mandalay Monarchy was limited to such hillfoots where green copper occurrences are seen.

(2) Gangue Minerals

Gangue minerals are mostly quartz, and it is observed to have been continuously from the earliest stage towards the end of the mineralization.

In most cases, quartz grains were concentrated in silicified zones as crystals of the sizes less than 100 microns, disseminated in the country rocks. They are also observed as aggregates of small crystals replacing country rocks. Small quartz veinlets were introduced at the later stage, cutting pyrite veins or filling up the middle of the comb-structures of pyrite mass. Usually they are as thin as less than 2 mm. There are fine quartz crystals grown in druses of pyrite mass.

Strong silicification coincides to rich mineralization, and is thought to be closely related to it. Rarely, calcite is observed in form of veinlets. As for the Sabedaung ore deposit, calcite is recognized to be included in tuffs in the cores of a few drill holes located in the outer margin of the deposit. It is thought that these calcites are products at the last stage of the mineralization, as they cut pyrite or quartz veins.

(3) Clay Minerals

1) Kaolin and alunite are most abundant and sericite is associated with rich mineralization. They were identified by X-ray refraction in the previous year's survey.

Generally, kaolin and alunite are alteration products after plagioclase in porphyritic rocks. Alunitization is seen in and around the silicified zones, and it is usually surrounded by kaolin zones. Alunite is light crimson-red to white in color, and forms aggregate of sheet-like or fibrous small crystals. The process of kaolinization is recognized in porphyritic rocks by the following evidences;

a) Phenocrysts of plagioclase to turn white from light color.

b) Structure or texture of plagioclase phenocrysts to fade out extinguishing.

c) Plagioclase phenocrysts to be completely replaced by kaolin minerals.

d) Kaolinization to penetrate into groundmass.

e) No trace of phenocrysts to be found in the part strongly kaolinized, leaving homogeneous texture composed merely of kaolin minerals.

Sometimes biotite phenocrysts were found to have been kaolinized. Remarkable kaolinization is recognized mainly in tuff zones along the boundary of lava domes and tuffs, as well as in the marginal part of lava domes.

### 3-3 Rock Alteration

1) From the examinations of the cores of the diamond drilling in the known ore deposits of Sabedaung, Kyisindaung and others, it has become evident that the richest mineralization lies in intensely silicified and alunitized zone carrying concentration of pyrite, surrounded by the argillized zone composed mainly of kaolin minerals.

2) Though the rocks on the surface are thoroughly oxidized and leached, evidences of silicification and alunitization are usually well preserved and the pyrite concentration is represented by iron gossans as the result of hematitization and limonitization.

3) The rhyolite dykes were well developed along the structural linears

of NW-SE, N-S and E-W, in and around the lava domes. The remarkable alteration is usually recognized along the rhyolite dykes or along the brecciated zones around them.

4) As for the known ore deposits, the strong mineralization is seen in such areas as given below;

a) Where remarkable alteration as intense silicification and alunitization is recognized.

b) Where presence of many iron gossans are observed in close order as the result of hematitization and limonitization.

c) Where network-fissures and brecciated zones are well developed.

d) Where many rhyolite dykes showing brecciation are found to be present.

Rich mineralization has been found underneath the area where intense silicification, alunitization, limonitization and hematitization are recognized overlapped, as mentioned above.

5) From the knowledge obtained through the present detailed geological survey, it has become evident that the areas where the above four geological conditions are satisfied would be recommended to warrant further exploration positively.

In the Monywa area, the following two areas are considered to require further investigation in future, as they are thought to satisfy the above four geological conditions;

1. Sabedaung South about 70,000 $m^2$

2. Letpadaung about 3,000,000 $m^2$

It is necessary prior to the diamond drilling to correlate the IP result to that of the geological survey, in order to locate the potential area or target precisely, where IP anomaly is coincident to the indications shown by the above-mentioned four geological conditions.

3-4 Mineralization

1) The summary of the relation between volcanic activities and mineralization in Monywa area is given below in chronological order, on the basis of the geological data obtained through the present geological survey.

(1) Volcanic activity of the hornblende-biotite porphyries during the period of the accumulation of the upper part of the Magyigon Formation.

(2) Formation of the domes of biotite porphyries.

(3) Intrusion of the rhyolite dykes in and around the lava domes, and mineralization associated with it.

(4) Volcanic activity of the rhyolite intrusive bodies of post-mineralization.

2) The volcanism in relation to the mineralization in the Monywa area, is thought to have been a successive activities, from the following points;

a) There is no evidence of sedimentation of sandstone or mudstone, between the activity of hornblende-biotite porphyries and the formation of the lava domes.

b) The volcanic activity of the rhyolite dykes related to the mineralization did not reach to the sandstones and mudstones of the uppermost Magyigon Formation, comprising Kyaukmyet and Shwebonthang.

3) The succession of the volcanic activities is in the following order;

1. hornblende-biotite porphyry
2. biotite porphyry, free from hornblende
3. activity of rhyolite

This succession is thought to show a development of magmatic differentiation, transforming from basic side to acidic, which is also seen in Taungzone, Sagedaung, Kyisindaung and Letpadaung. However, in Taungzone sector, although biotite-quartz porphyries are observed to have intruded in lenticular shape into the lava domes of hornblende-biotite porphyries, no evidence was found of the rhyolite intrusion. In other words, the volcanism in this Taungzone sector ceased after the activity of the hornblende-biotite porphyries. Biotite-quartz porphyries were introduced as lenticular dykes along the fissures in the hornblende-biotite porphyries at the time of the formation of the lava dome in the upper part of the Magyigon Formation. The fact that there was no rhyolite activity in this Taungzone sector after the intrusion of the biotite porphyries is thought to suggest that the volcanism related to the mineralization in Monywa area was very feeble in this sector.

4) From the core log of the drill holes located in Sabedaung, Kyisindaung, Sabedaung South and Letpadaung sectors, it can be said that the mineralization was brought into shallow places under the low temperature environment, in view of the following points;

a. Alunite, a sulphate mineral, is commonly recognized in and around the silicified zones.

b. In Kyisindaung or in Sabedaung South, enargite is discerbible, though generally scarce, in shallow to deeper part of 29 m to 275 m below surface.

Also, it is thought that the crystallization temperature of pyrite was low as well, because the pyrite, the most abundant mineral of those composing ore deposits, is observed

1. to be disseminated in alunitized zones or
2. to cut alunites in the form of fine seams, but
3. no alteration effect was recognized in the alunites or alunitized zones given by the pyrite, under microscope.

As for chalcopyrite, some of it were found in pyrite crystals as fine grain inclusions, and it is thought that chalcopyrite was crystallized at the same period of the consolidation of pyrites.

5) Rock alteration is observed to have been developed as haloes around rhyolite dykes. Generally, the zoning of rock alteration is as follows and rich mineralization is seen associated with remarkable silicification zone in the central part.

1. Central -------- silicification zone
2. Middle -------- alunitization zone
3. Outer -------- argillization zone (kaolinization)

As for mineralization, it is inferred from the above zoning of rock alteration that sulphide minerals deposited contemporaneously with silicification and sericitization, preceded by kaolinization and alunitization. Also, it is presumed that the reaction of the rock alteration would have changed gradually from acidic character to basic. In view of the presence of the aforesaid alunite and its paragenesis with kaolin minerals, it is considered that the ore deposits in the Monywa area were formed as the results of shallow epithermal mineralization.

As there are small patches of chalcopyrite in pyrites, the primary copper mineral is thought to have been chalcopyrite. The copper content of the primary mineralization zone has been suggested to be very low, by the 9 drill holes completed by the Japanese survey team in 1973. They caught the primary mineralization zone free of chalcocite in the deep part, where the average copper grade was as low as 0.17%.

6) In this Monywa area, volcanism ceased after the period of the predominant mineralization, and the sandstones and the mudstones of uppermost Magyigon Formation were accumulated in the basin.

The Tertiary volcanism in this area was terminated by the rhyolite intrusion into the uppermost Magyigon Formation, as seen in Shwebonthataung and in Kyaukmyet sector, preceded by the activity of tuffs. The rhyolites in the above two areas are known to have given some alteration effect to the surrounding country rocks. However, in the rhyolites themselves, only local and weak pyritization and silicification are recognized, and the aforesaid four geological conditions for a favorable area are not likely to have been fulfilled. A hole was drilled against an IP anomaly in the Kyaukmyet sector in the present survey. But neither the evidence of the mineralization nor the alteration of the country rocks was recognized in the core of the drill hole, although flakes of reductive pyrites were found scatteringly in two parts of the mudstone of the Magyigon Formation, 60 - 90 m and 160 - 170 m below surface.

It is considered from the above that there would not have been such intense mineralization as to form economical ore deposits in these areas.

## CHAPTER 4 DESCRIPTION OF EACH ORE DEPOSIT

### 4-1 Sabedaung Ore Deposit

1) The Sabedaung ore deposit lies in the lava dome of the biotite porphyry formed to have penetrated the tuffs of the upper Magyigon Formation.

The sizes of the lava dome are as follows;

| | | |
|---|---|---|
| Width ( E-W ) | approx. | 400 m |
| Extension ( N-S ) | approx. | 600 m |
| Area | approx. | 240,000 $m^2$ |
| Relative hight to the plain level | | 80 m |

The most appreciable progress has been made in the exploration works in this area among the Monywa ore deposits and their surroundings. That is to say, 55 drill holes totalling 9,955.2 m were completed, for this Sabedaung ore deposit. 41 of the 55 holes were drilled by MMDC, totalling 7,632.8 m and the rest 14 holes were done by Japanese survey team, with the total length of 2,322.4 m.

Historically, the drilling in this area started in the north side of the Sabedaung hill and was put forwarded to the south. In its early stage, the drilling was carried out in irregular grid spacing of 20 to 30 meters in the northern part. However, after this test stage was finished, the well-ordered exploration program was established to cover whole of the hill with the grid system of 300 ft. spacing, and 41 holes were drilled according to this new program by MMDC. First ore reserve estimation was made at this time, and the inferred ore reserves were announced to be 22 million tons with the average Cu-grade of 1.03% by MMDC in 1972.

2) In 1973, 12 holes were drilled in the central part of the Burmese grid exploration area, by the Japanese survey team, for the purpose to check the continuity of the orebodies and to collect samples for mineral processing test. The results were remarkable in that the copper grades were almost equal to those obtained in the closest Burmese holes.

In addition to the results of these 12 holes, cores of the previously drilled 55 holes were examined carefully as for the distribution and the characters of the network veinlets, especially. Giving further consideration to the mineralization encountered in the clined holes (-45°) carried out by MMDC, on the above results, it was confirmed that the ore zone would be continuous horizontally.

Based on this conclusion, the ore reserve was estimated roughly as follows;

| | |
|---|---|
| Average extension | approx. 500 m |
| Average width | approx. 350 m |
| Average thickness | approx. 60 m |
| Specific gravity | 2.5 |
| Ore reserve | roughly 25.7 million tons |
| Average Cu-grade | 1.01 % |

The overburden of the oxidized and leached zone covering the secondary enrichment zone is as thick as 26 meters in average. As is seen, the stripping ratio of the ore deposit is under 1, and the condition for mining is excellent.

It is thought that no more exploration works are required for this Sabedaung ore deposit and that it is the time to carry out mining test and mineral processing test for the development and the operation of the mine, as for this ore deposit.

4-2 Kyisindaung Ore Deposit

1) First of all, the sizes of the Kyisindaung lava dome are given below;

| | | | |
|---|---|---|---|
| Width | ( E-W ) | approx. | 1,000 m |
| Extension | ( N-S ) | approx. | 1,200 m |
| Area | | | 1,200,000 $m^2$ |
| Relative hight to the plain level | | | 190 m |

The base of the lava dome is composed of hornblende-biotite porphyry, tuff, sandstone and mudstone of the upper part of the Magyigon Formation. The so-called Kyisindaung lava dome is, virtually, a composite dome composed of the three small domes. The intense alteration and mineralization are recognized in an area of 400,000 $m^2$, approximately 1,000 m long and 400 m wide, including two of the three small lava domes, sitting in an alignment of NE to SW.

2) In and around the Kyisindaung ore deposit, drilling of 72 holes totalling 20,069.2 m was completed before the end of July, 1974, the breakdown of which is given below;

| | | | |
|---|---|---|---|
| 67 holes | total | 18,563.1 m | by MMDC |
| 5 holes | total | 1,506.1 m | by Japanese survey team |

Six more holes of the total length of 1,149.3 m are currently underway by MMDC. Also, drilling of 18 holes (depth 300 m each) is in the present program to be carried out amid the existing drill grid.

In the Kyisindaung sector, a program of the drill grid with 100 m (300 ft) spacing was established over the area from the north-eastern hillfoots to the southern part of the lava dome, and the drilling has been carried out in order from north to south.

Based on the results of the 72 holes completed before the end of July, 1974, possible ore reserve was estimated as follows;

| | |
|---|---|
| Possible ore reserve | 66.54 million tons |
| Average copper grade | 0.77% |

3) In the Kyisindaung sector, chalcocite enrichment is observed in two zones horizontally, in the upper concentration zone of 100-150 m and in the lower concentration zone of 250 to max. 400 m below surface. By the field observation and by the data of the drilling, it has been confirmed that the Kyisindaung dome is bordered by the two parallel faults of NE-SW trending, along which the dome itself slipped down and subsided against the surrounding country. It is inferred from the above that there had been some chalcopyrites left unleached by the time of this fault movement, and that they were leached, transported, redeposited and enriched to compose upper ore horizon, after the subsidence of the lava dome.

Meanwhile, the altitude of the Monywa plain is about 80 m above level, while the top of the lower ore horizon is almost 170 m below sea level. The main ore mineral composing the lower ore body is secondary chalcocite. Accordingly, it would be appropriate to elucidate these facts by the assumption that this secondary enrichment was completed naturally at the altitude higher than that at present. This assumption will assist to hold the above idea of the subsidence of the Kyisindaung lava dome.

4) The southwestern limit of the Kyisindaung ore deposit was confirmed by the drilling performed by the Japanese survey team in 1973. The works left in future are to carry out supplementary drilling in the lava dome, to investigate the lower unexplored part and to check the continuity of the present ore bodies, for the further detailed information of the Kyisindaung ore deposit.

### 4-3 Mineralization at Letpadaung

1) Letpadaung sector is the place where the oldest exploration in th Monywa area was carried out.

The sizes of the lava dome are as follows;

| | |
|---|---|
| Distance across ( E-W ) | approx. 3,000 m |
| Width ( N-S ) | approx. 2,000 m |
| Area | 6,000,000 $m^2$ |
| Relative hight to the plain level | 240 m |

The zone bearing intense mineralization and alteration is recognized in the north and in the north-eastern parts of it, the total area of which is approximately 3,000,000 $m^2$. This zone is known to reveal high IP anomaly by the geophysical prospecting completed by the Japanese survey team in 1973, and is considered to be highly potential area to warrant further exploration.

2) In 1955, Yugoslavian survey team carried out some exploration works by self-potential method of the electrical prospecting. Subsequently in 1957,

the Burmese government (MRDC) completed 25 holes of diamond drilling. By the results of the electrical survey then carried out, self-potential anomalies were detected in the area around the northern hillfoot of the lava dome, where sulphate minerals are locally concentrated.

The secondary chalcocite enrichment zone, as the target of the present geological survey, is expected to lie underneath the central part of the hill, in view of the distribution of zoning of the alteration. The most remarkably altered zones are recognized at the seven localities as shown on the Rock Alteration Map in Letpadaung Sector (PL I-3-3), where further drilling exploration will be required to obtain the informations about the form and the mode of the mineralization.

## CHAPTER 5 GEOLOGY OF THE DIAMOND DRILLING

The following diamond drilling was completed by the Japanese survey team in 1973.

| Sector | Number of holes | Total length |
|---|---|---|
| Sabedaung | 12 | 1,812.3 m |
| Kyisindaung | 3 | 904.3 |
| IP anomalies | 3 | 602.8 |
| Total | 18 | 3,319.4 |

IP anomalies

1) to the south-southwest of Sabedaung South (LN-4)
2) to the south of Kyisindaung (LN-3)
3) Kyaukmyet (IP-3)

### 5-1 Sabedaung Sector

Diamond drilling of 12 holes totalling 1,812.3 m was carried out in the Sabedaung sector. Nine of the 12 holes were drilled along the extension of the ore deposit amid the Burmese grid exploration area in the central part of the Sabedaung lava dome. The rest three were situated in the immediate surrounding zone of the Sabedaung ore deposit.

The purpose of the diamond drilling was;

1) to check the continuity of the ore zone by the drill holes amid the Burmese grid of 100 m spacing,
2) to check the extension and the limit of the ore deposit by locating

the drill holes in the peripheral zone of the deposit, and

3) to collect core smaples for the mineral processing test.

The above purpose was almost completely accomplished by the drilling and the results were excellent in that the continuity of the ore zone was confirmed, and that the ore reserve has been increased by this drilling.

Also, it is particularly notable that the actual shape of the Sabedaung lava dome, which is thought to have controlled the form of the ore deposit, has been clarified by the drilling, as this is very contributive to the delineation of the ore deposit.

## 5-2 Kyisindaung Sector

Three holes were drilled along the southern hillfoots of the Kyisindaung hill, where an IP anomaly was detected by the geophysical survey in 1972. The depth of each hole was 300 meters.

Each of the above three holes caught mineralization, and the mode of mineralization around the southern end of the ore deposit was brought into light. From the fact that the sandstones and the mudstones of Magyigon Formation were intersected in the lowest part of the drill holes, it is thought to have been evidenced that, as of the other deposits, the ore bodies in the Kyisindaung ore deposit were emplaced in the lava dome as well. The above drill results were much contributive to the consideration of the shape and the form of the lava dome.

The parts of the drill holes where the sedimentary rocks were penetrated are given here;

| Hole No. | Depth |
|---|---|
| 19 A | 264 m ~ 284 m, 322 m ~ the bottom. |
| 19 D | 268 m ~ the bottom of the hole. |
| 21 C | 105 m ~ the bottom of the hole. |

As stated above, each of the drill holes caught the sedimentary sequences at the base of the lava dome, and it has been confirmed that the rock body of the biotite porphyry is rather thin along the marginal part of the lava dome.

5-3 Drilling for IP Anomalies

(1) LN-4 (201.2 m) at the southeast of Sabedaung South.

The rocks caught by this drill hole were mostly sandstones, mudstones and tuffs of the Magyigon Formation. Between 37 m and 80 m, dykes of biotite porphyry with maximum thickness of 6 meters were intersected. Dissemination of pyrite was observed down to the depth of 110 m.

(2) LN-3 (201.0 m) at the south of Kyisindaung.

Alteration of the units of sandstone, mudstone and tuffs of Magyigon Formation and the lavas of hornblende-biotite porphyry was caught. In the sandstone along the border to the hornblende-biotite porphyry, at the depth of 40 - 60 m and 100 - 110 m, remarkable dissemination pyrite was recognized.

(3) IP-3 (200.6 m) at Kyaukmyet.

The whole length of the core recovered is composed of the alternation of sandstones and mudstones of the uppermost Magyigon Formation.

Pyrite is seen scattered at the depth of 60 - 90 m and 160 - 170 m.

From the above-mentioned, it has been clear that the IP anomalies in the plain area are merely due to pyrite dissemination, and that the country rocks are generally fresh and are not related to the copper mineralization directly.

# CHAPTER 6 ORE RESERVE ESTIMATION

## 6-1 Procedure of Calculation

The ore reserve estimation was accomplished by delineating the ore deposit for calculation based on the performances of the geological survey, the geophysical survey and the diamond drilling, with the results of sampling and chemical analysis.

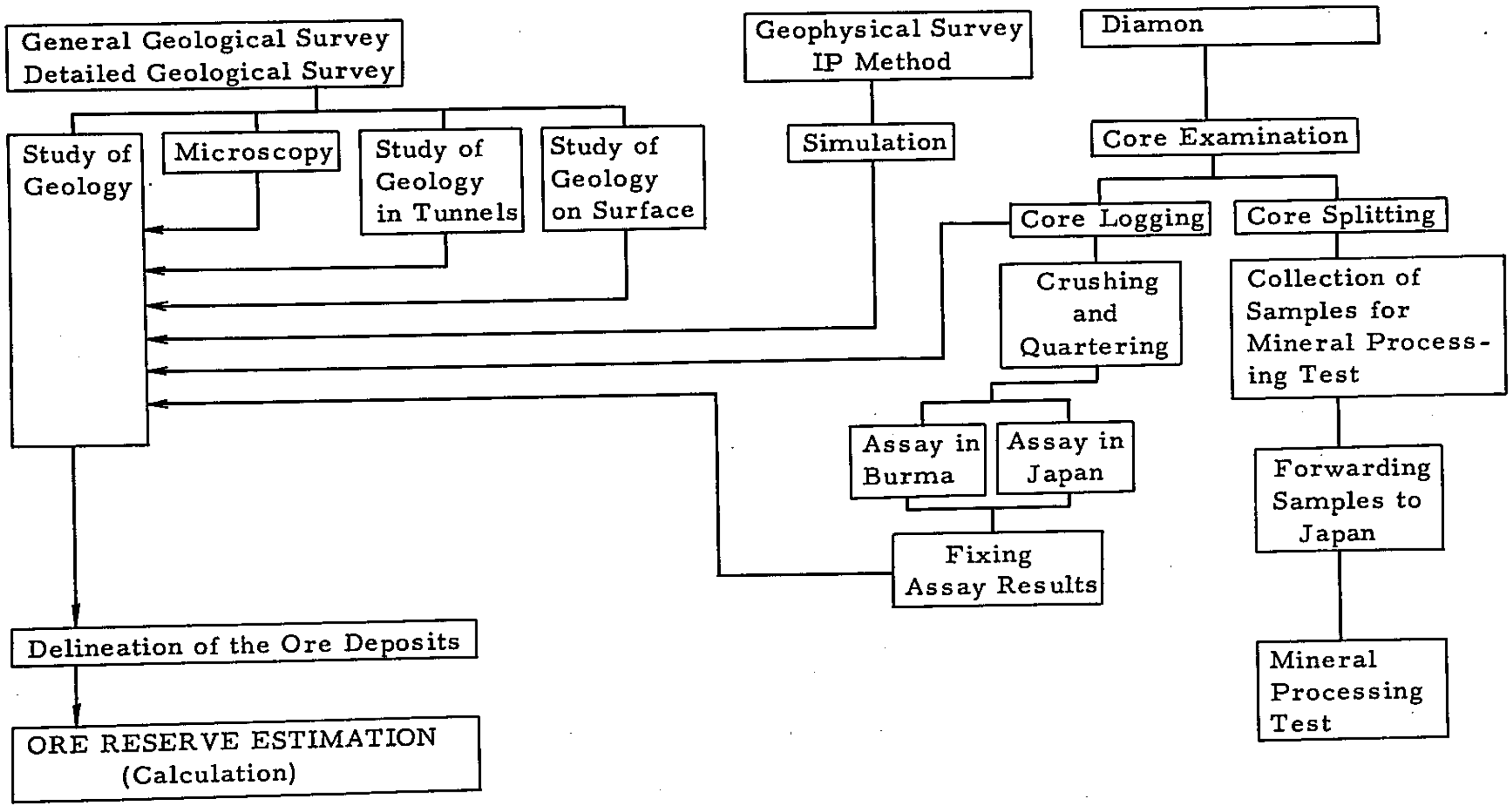
The flow-sheet of the procedure of the works for the ore reserve estimation is given on the next page.

The drill cores of the 12 holes in Sabedaung sector were examined and recorded on the core logs scaled 1 to 300. All the cores were split into halves, referring to the completed core logs. A half of the split core was left in the core boxes, while the other half was collected to make samples of every 2 meters, which were crushed and rendered to quartering repeatedly to prepare assay samples under 100 meshes of the grain size.

Those assay samples prepared from the drill cores in Sabedaung sector were forwarded partly to Japan for assay and were partly analysed at the D. G. S. E. laboratory in Burma.

As for the split cores of the drill holes in the other sectors, assay samples were prepared only from the mineralized parts of the drill cores, including low-grade mineralization, and were analysed in Japan, in the same way as those in Sabedaung sector.

# FLOW SHEET OF WORKS



## 6-2 Discussion about Ore Grade

Table I-3 shows each method of the chemical analysis employed by the laboratories in Japan and in Burma.

The method of the chemical analysis taken by the Japanese laboratory was to add acid to the sample and to heat the whole solution, followed by the filtration, after which copper content in the filtered solution was analysed by the atomic absorption method.

The method of the chemical analysis employed by the Burmese laboratory was to add acid to the sample and to heat the whole solution, followed by the filtration, after which copper content in the filtered solution was analysed by the titration method.

The precision of the analysis does not differ so much between those two methods.

### 6-2-1 Comparison of the Assay Results

Examples of the assay results of the copper content in the 721 samples, prepared from the 12 holes in Sabedaung sector are shown in Fig. I-3 and in Fig. I-4, for the comparison of the results obtained by the Burmese method and by the Japanese one.

Fig. I-3 and Fig. I-4 were drawn for the dispersion of the assay results, taking ordinate for Japanese results and abscissa for Burmese results. If the assay results by the two methods are equal, they are naturally plotted on the 45° line to the abscissa. The area of the ordinate side of this 45° line shows the excess of the Japanese assay results, while the area of the opposit abscissa side means that the Burmese assay results are higher than Japanese ones.

## Comparison of the Methods of Chemical Analysis by MMDC of Burma and by MESCO in Japan

### MMDC

Sample 0.5 - 1.0$^{gr}$

- HCl (15-20$^{ml}$)
- $HClO_4$ (15$^{ml}$)

Evaporation for Consolidation followed by Natural Cooling

- $H_2O$ (50$^{ml}$)

Heating and then Natural Cooling

Filtration

- Residue

Filtered Solution

Heating

- $NH_4OH$
- $CH_3COOH$

Natural Cooling

- NaF

Volume Arrangement

- (adding $H_2O$ up to total 50 ml)
- KI (2 gr)

Shaking

Titration $Na_2S_2O_3$

Cu %

### MESCO

Sample 0.5 - 1.0$^{gr}$

- HCl (10$^{ml}$)
- $HNO_3$ (10$^{ml}$)

Heating for Solution

Evaporation for Consolidation

- HCl (5$^{ml}$)

Re-drying up

- $HCl+H_2O$ (1:1 10$^{ml}$)

Filtration, Cleaning

- Residue

Filtered Solution

Volume Arrangement

- (adding $H_2O$ up to total 100 $^{ml}$)

Atomic Absorption

Cu %

* Assay for total Cu.

Fig. I-3 Correlation of Assay Results of Copper (JS-3)

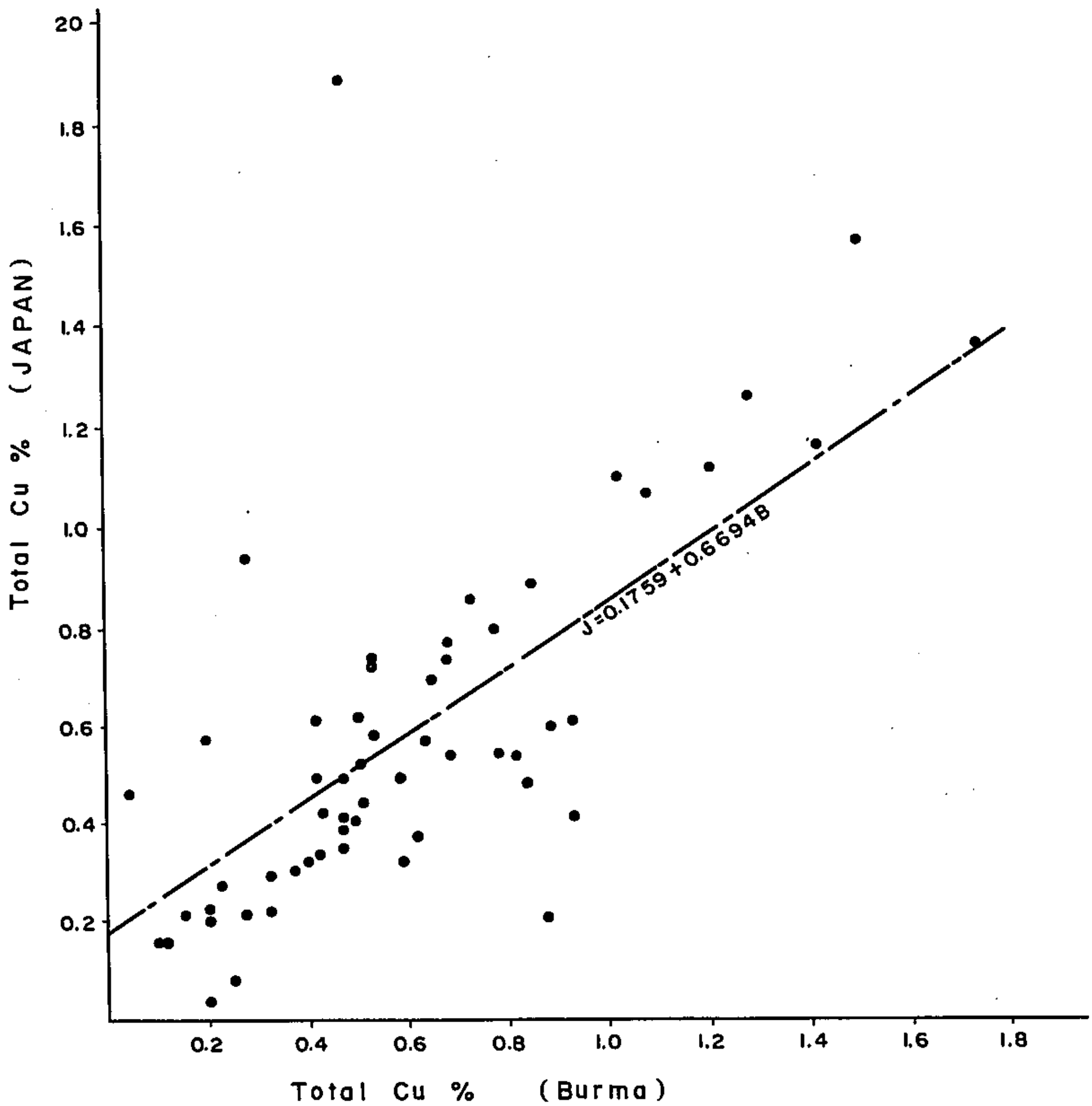
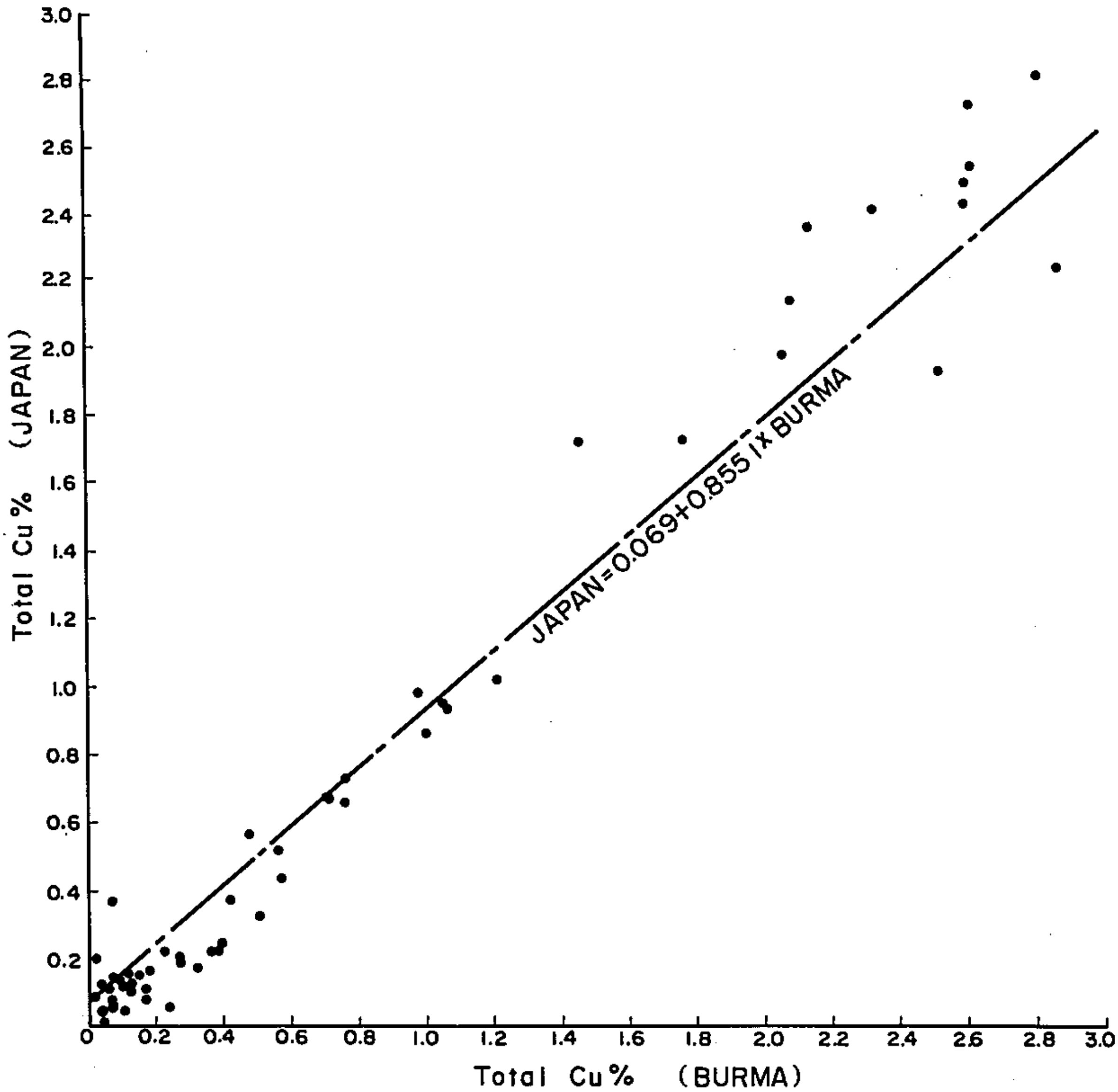


Fig. I-4 Correlation of Assay Results of Copper (JS-4)



Since the points actually plotted are seen dispersed in a certain range along the 45° line, it has been confirmed that there is no significant difference of the assay results obtained by the two methods, according to the statistical difference check.

The regression lines of the assay results by the both sides are shown on Fig. I-3 and on Fig. I-4. The correlation of the assay results by the two methods is given in Fig. I-5, separately in the ranges of every 0.25 percent of Cu-grade. This correlation was obtained by plotting whole of the assay results of the 721 samples from the drill holes JS-1 to JS-12, in each range of every 0.25% Cu.

As seen in Fig. I-5, there is not much difference about the regression lines in the ranges of 0.25 to 1.9% Cu, from the regression line covering the whole ranges, in their position and their inclinations. However, in the ranges of Cu-grade under 0.25% and over 1.9%, the regression lines do not coincide with the one covering the whole ranges, the former slightly, but the latter quite considerably as the inclinations are irregular and the positions are rather free.

The following regression formulas have been obtained on the correlation of the assay results of the Burmese to those of the Japanese method.

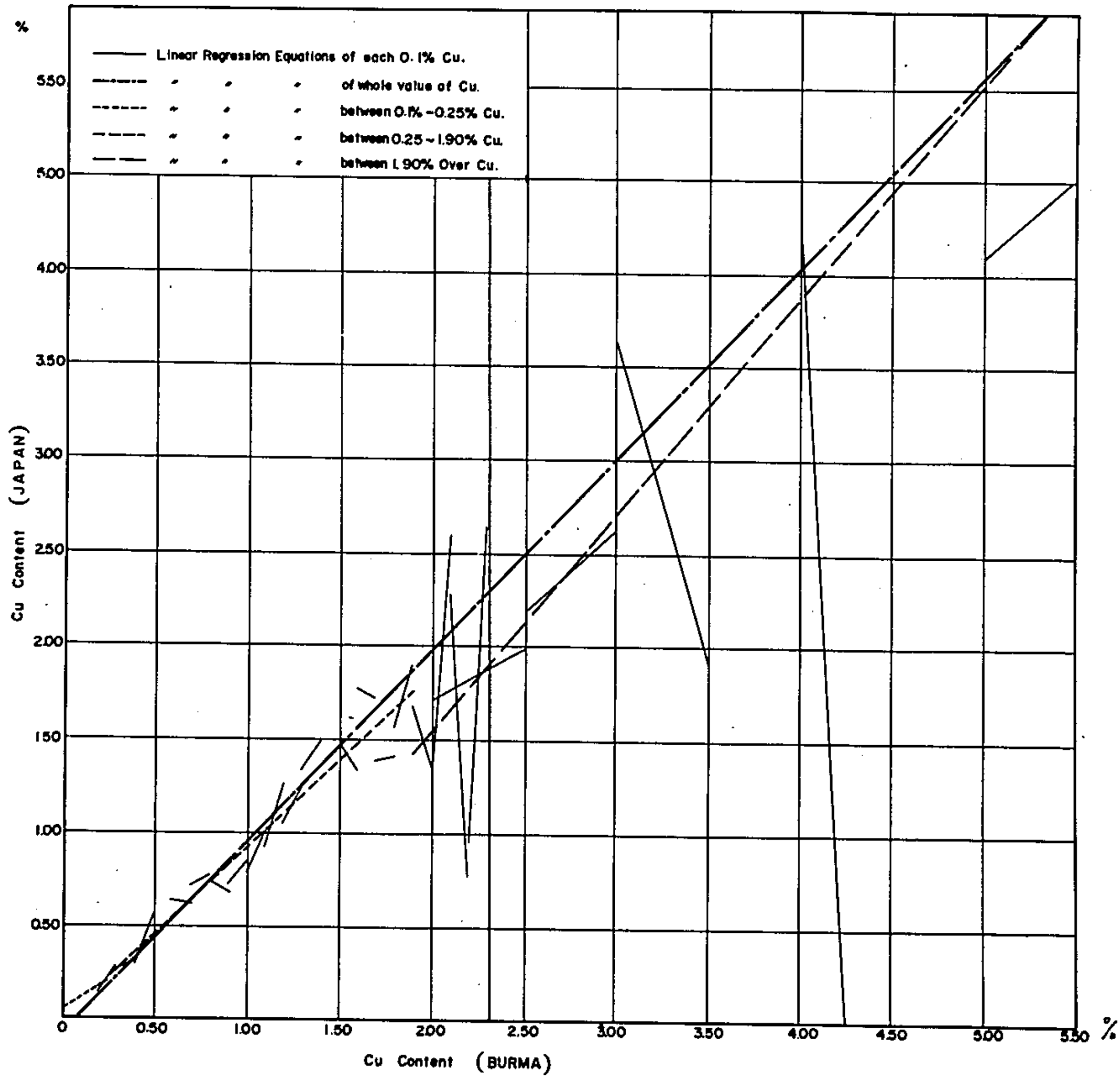
J : Assay results by Japanese

B : Assay results by Burmese

(A) Regression formula for all the assay results.

$$J = 0.0726 + 1.01760 \times B$$

Fig. I-5 Correlation of Assay Results of Copper (Total)



(B) For the Burmese assay results of nil to 0.25% Cu.

$J = 0.0460 + 0.60937 \times B$

(C) For the Burmese assay results of 0.25% to 1.9% Cu.

$J = 0.0048 + 0.93146 \times B$

(D) For the Burmese assay results of over 1.9% Cu.

J =

By the above formulas, it can be said that

(1) for the Burmese assay results under 0.25% Cu, Japanese results are lower,

(2) for the Burmese assay results of 0.25% to 1.9%, Japanese assay results are ob tained by multiplying the Burmese results by 0.93, and

(3) for the Burmese assay results between 1.9% and 5% Cu, Japanese results are lower, but in the range over 5%, Japanese results are higher, although the samples showing such high Cu-grade are as few as only 3 percent of the total 710 samples.

6-2-2 Grade Correction Factor

The following errors are expected to be present naturally in the ore grade used for the ore reserve estimation.

(A) Errors due to the treatment of the samples as core-splitting, crushing or quartering.

(B) Errors due to the processing of the samples for chemical analysis.

(C) Errors due to the possible local concentration of the copper deposition horizontally and vertically in the delineated ore deposit, as well as errors due to the insufficient numbers of samples collected.

(D) Errors due to the method of the calculation.

Accordingly, usually at mines in production, grade correction factor is employed as a safety factor on the assay results for the estimation of ore reserves.

In this case, Burmese assay results are generally higher in the ranges of Cu-grade over 1.9% and under 0.25%, though the differences are not taken significant. Whichever results may be used for the ore reserve calculation of the Monywa ore deposits in future, it is thought that it would give more appropriate figures to employ grade correction factor on the assay results.

However, the following ore reserve estimation was accomplished on the basis of Burmese assay results only, as the differences between Burmese and Japanese results are recognized not to be significant.

## 6-3 Basis of Calculation

1) Method of calculation ----- Scaled cross sectional method.

a) The ore reserve of Sabedaung ore deposit was estimated by means of parallel sections of NW-SE, spaced 20 m to 91 m each other.

b) The ore reserves of Kyisindaung ore deposit was estimated by means of the parallel sections of NW-SE, spaced 91 m each other.

2) Specific gravity ----- By the Burmese measurement.

The average of the specific gravity measurements of 2,922 samples from Sabedaung deposit ----- 2.5

The average of the specific gravity measurements of 1,504 samples from Kyisindaung deposit ----- 2.6

3) Cut off grade ----- 0.3% Cu by the Burmese assay results.

As the cut off grade of the 0.3% Cu had been taken as the base of the ore reserve calculation done in Burma, the same figure was employed here.

4) Upper limit of the ore grade

Burmese assay results over 5% Cu are treated as 5%, because the only 3 percent (22 samples) of the total 721 samples shows the Cu-grade over 5%.

5) Class of the ore reserve

As there is no proven part of the ore, as for the continuity of the deposit, directly by trenching or tunnelling, and all the data are based on the drilling and surface geology, the ore reserves are classified as "Possible Ores", according to the Japanese Industrial Standard.

6) Delineation of the ore deposit for the calculation

Even in case the extension of the orebody is expected in the spherical zone geologically, the extension was taken limited within the distance correspondent to the thickness of the ore zone encountered in the drill hole concerned. Although the continuity of the ore deposit between cross sections had not been proved, the estimation was accomplished on the assumption that the ore deposit is continuous.

7) Ore grade

Burmese assay results of the total copper content were used for the estimation, without imposing grade correction factor, and regardless the soluble copper content. Other valuable contents such as Au, Ag, S, Fe, etc. were neglected in this calculation as only little of them are contained in the deposits.

As for the Kyisindaung ore deposit, where the exploration works are currently underway, the results of the exploration including diamond drilling and assay results, used for this calculation of the ore reserves were those obtained before August, 1974.

## 6-4 Estimation of the Ore Reserves

### 6-4-1 Sabedaung and Kyisindaung Ore Deposits

The result of the estimation accomplished is given on the next page.

### 6-4-2 Letpadaung Ore Deposit and Others

The ore reserve of the Letpadaung ore deposit was not calculated in this report, as the deposit has not been well delineated yet, although it was partially proved by the drilling carried out by Burmese concerns in the past.

Another ore deposit caught by the drill holes at the south of the Sabedaung hill was neither calculated here as the numbers of the drill holes were not sufficient enough to delineate the ore deposit for the ore reserve estimation.

Ore Reserve Estimation of the Sabedaung and Kyisindaung Ore Deposit

| Ore Deposit | Class | Extension in Average | Width in Average | Thickness in Average | Specific Gravity | Ore Reserve | Cu-Grade |
|---|---|---|---|---|---|---|---|
| Sabedaung | Poss. | 500 m | 350 m | 60 m | 2.5 | 25,717,000 tons | 1.01 % |
| Kyisindaung | | | | | | | |
| A-orebody | Poss | 800 | 400 | 65 | 2.6 | 60,581,000 | 0.77 |
| B-orebody | Poss. | 300 | 120 | 45 | 2.6 | 4,383,000 | 0.81 |
| C-orebody | Poss. | 300 | 120 | 15 | 2.6 | 1,574,000 | 0.54 |
| Total of Kyisindaung | Poss. | | | | | 66,538,000 | 0.77 |
| TOTAL | Poss. | | | | | 92,255,000 | 0.84 |

* Poss. = Possible Ore Reserve

# PART II GEOPHYSICAL SURVEY

# PART II GEOPHYSICAL SURVEY

## Part II Geophysical Survey
## (Electric Prespecting by Induced Polarization Method)

Part II Geophysical Survey

(Electric Prespecting by Induced Polarization Method)

## List of Figures



## List of Tables

## List of Plates (Attached in Pocket)

## Chapter 1 General

### 1-1. Outline (PL II-1-1, Fig. II-1)

(1) IP (frequency domain in dipole-dipole configuration)

(2) Total length of lines surveyed : 92.7 line-km

(3) Total number of lines surveyed : 19 lines

| Name of line | length | Numbers of measurement | line spacing |
|---|---|---|---|
| No. 12 | 6.6 km | 250 points | 600 m |
| " 13 | 6.3 " | 238 " | " |
| " 14 | 8.0 " | 306 " | " |
| " 15 | 8.4 " | 322 " | " |
| " 16 | 7.4 " | 282 " | " |
| " 17 | 3.2 " | 114 " | 300 m |
| " 18 | 3.5 " | 126 " | " |
| " 19 | 3.5 " | 126 " | " |
| " 20 | 3.5 " | 126 " | " |
| " 21 | 3.8 " | 138 " | " |
| " 22 | 5.3 " | 198 " | " |
| " 23 | 4.0 " | 146 " | " |
| " 24 | 4.0 " | 146 " | " |
| " 25 | 3.7 " | 134 " | " |
| " 26 | 4.4 " | 162 " | " |
| " 27 | 4.4 " | 162 " | " |
| " 28 | 4.7 " | 174 " | " |
| " 29 | 3.0 " | 106 " | " |
| " 30 | 5.0 " | 186 " | " |
| Total | 92.7 km | 3,442 points | |

(4) Areal extent : approximately 39.7 $km^2$

(5) Line spacing : 300 m & 600 m

(6) Electrode interval : 100 m

(7) Electrode separation factor : N = 1, 2, 3, 4

(8) Depth of measurement : upto 250 m in apparent depth

(9) In-situ measurement : 39 stations

(10) Investigation period : field survey, Dec. 19, '73 - Mar. 7, '74

interpretation, Mar. 8, '74 - Aug. 31, '74

(11) Geophysicist engaged : 15 Burmese & 4 Japanese

(12) Equipment used : McPhar IP transmitter 2004

" IP receiver 29D

Yokohama Electronics IP receiver Y1-804

(13) Others :

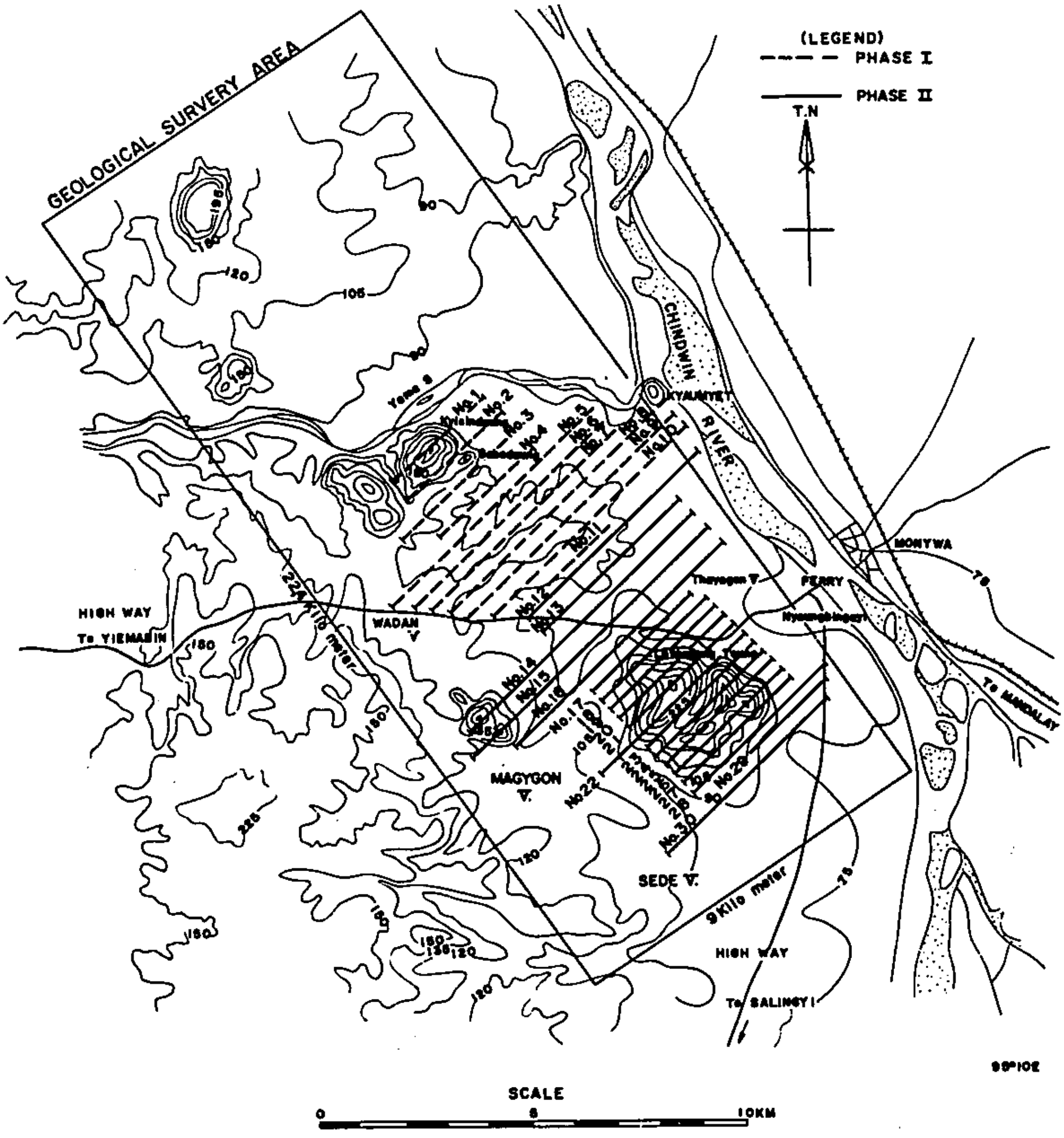
1) Vertical electric sounding (Schlumberger's)

two locations on No. 17 line

2) Electromagnetic coupling test

on No. 28 line

Fig. II-1 Location Map of the IP Surveyed Area Phase I & II



## Chapter 2 Method

### 2-1. Principle

The principle of the induced polarization method (abbreviated to IP hereafter) is based on the electrochemical phenomenon of overvoltage, that is on the establishment and detection of double layers of electrical charge at the interface between ionic and electronic conducting material when an electrical current is caused to pass across the interface.

The apparent resistivity (hereafter expressed as AR) and the frequency effect (hereafter as FE) of the minerals of the host rocks are measured by applying the principle mentioned above. g the principle

Actually the resistivity varies by the change of the frequency of the sending electric current, especially in the mineralized bodies, because of the fact that the impedance of the rocks increases when the frequency of the current becomes lower. Then FE can be conveniently used for prospecting the mineralized bodies.

The method, operated by changing the frequency of the sending current and called frequency domain, was adopted in the present survey.

Those deposits, in which sulphide minerals exist as veinlet and dissemination, generally show bigger capacitive reaction by their electronic conductive minerals and also show higher FE than in the other deposits whick bear the same amount of sulphide in other forms.

However, as the clay minerals, graphite, etc. also have frequency effect, they give noise to an ambiguity in the interpretation of the IP data in some occasions.

## 2-2. Equipments

The chief specifications of the equipments used for the survey are as follows:-

Transmitter : McPhar Model 2004

| | | |
|---|---|---|
| Weight | Approx. | 20 kg |
| Maximum input power | | 2.5 kW |
| Output voltage | | 0 - 850 V |
| " current | | 0 - 5 A |
| Frequency range | | 10 cps - 0.1 cps |

Receiver : McPhar Model 29D

| | | |
|---|---|---|
| Weight | Approx. | 10 kg |
| Input impedance | | 1.9 M |
| Sensitivity (full scale) | | 500 $\mu$V |

Engine generator : J.L.O.

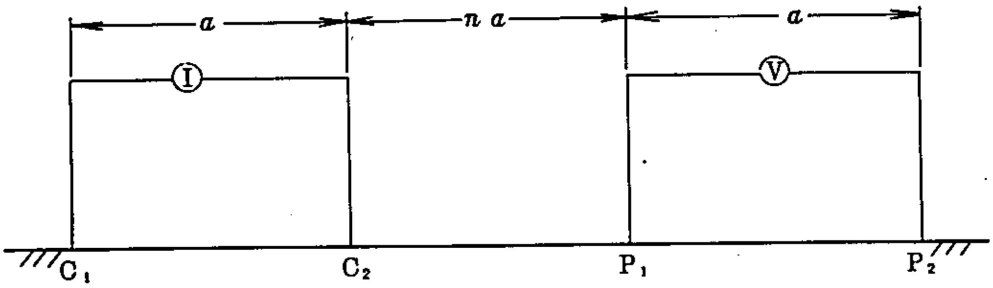
| | | |
|---|---|---|
| Weight | Approx. | 34 kg |
| Maximum input power | | 2.5 kW |
| Output voltage | | 125 V |

Stand-by receiver : Yokohama Electronics Model Y1-804

| | | |
|---|---|---|
| Weight | Approx. | 12 kg |
| Input impedance | | 10 M |

## 2-3. Measuring procedures

The survey was done by the dipole-dipole electrode configuration as shown in the following scketch.




where, $C_1$, $C_2$ : current electrodes

$P_1$, $P_2$ : potential electrodes

I : transmitter

V : receiver

a : electrode interval

n : electrode separation factor (1, 2, 3, 4 ...)

In practice two kinds of electric potentials, corresponding to the frequencies of 2.5 cps and 0.3 cps, are measured between the potential electrodes $P_1$ and $P_2$, separated at the distance of Na from the current electrodes $C_1$ and $C_2$ which are also separated in the fixed interval of "a" from each other.

100m was given to the "a" in consideration of the depth of the top of the known ore deposits, and the efficient performance of the survey. By changing the separation distance between the current electrodes and the potential electrodes, by 100, 200, 300 and 400m, the measuring points were plotted as deep as 250m.

2-4. Field procedures

Field procedures were done in the following successions;

Survey line setting, clearance, topographic survey, peg setting for IP stations (every one hundred meter in horizontal interval), digging holes, copper plate setting for electrodes, salt water pouring, wire setting (vinyl-insulated electric wire, 1.2 square millimeters in sectional area), IP measurement, and wire recovering.

All the works were carried out systematically in the best cooperation of all geophysicists and local helpers.

### 2-4-1. Layout of survey lines

The spacing of the survey lines was set as 300 m in and around of the Letpadaung hill, and 600 m in other areas.

The reason is that in the phase I survey, most of the IP anomalies were found in and around the prominent portions of topography, and were scarce on the flat plain in general.

Whenever some strong IP anomaly had been caught in between the 600 m spacing, an additional survey line would be able to be put in the middle of the lines to complete a 300 m spacing to detect it more in detail.

The direction of the lines was fixed as N45°E, just the same as in the phase I after considering the following facts;

(1) Convenience in the correlation of the survey results, because all the 11 surveyed lines had been set parallel in N45 E direction in the phase I.

(2) The Letpadaung hill, of which several mineralized locations are known, is scheduled to be surveyed in the shorter spacing of 300 m, so even if the line direction is not precisely intersecting

the supposed geological structure, almost all the anomalies can be expected to be detected in the shorter spacing of 300 m even in the line direction of N45°E.

### 2-4-2. Base line setting

The base line No. 2 of last year running in south east direction and once used for setting 6 survey lines from No. 6 to No. 11 in the phase I survey, was extended in the same direction of S45°E and taken as the base line for the phase II survey.

In practice, after ascertaining the starting point (00) on the line No. 8 of the phase I survey, a point was chosen for the starting point of the line No. 12 at the distance of 1,200 m horizontally from the former starting point.

Then, the base line, up to the intersection of the line No. 16, was marked every 600 m to indicate the point for the individual survey line. After the line No. 16 to No. 30, the spacing of every 300 m was marked on the base line.

### 2-4-3. Setting of current electrodes

The hill sides in the survey area are covered by mainly deciduous trees thinly, and the ground are mostly arid. In order to have the lower grounding resistivity and send larger current for the earth as much as possible, it was necessary to set copper-plate electrode at the bottom of a pit of about 0.8 m x 0.8 m, deep to the fresh ground. Salt water was poured for the pit as a principal rule both on one day ahead of the measurement and immediately before the measurement.

Then the pit was covered by grass and leaves to prevent the water evaporation by sun shine.

In the east of the Letpadaung hill and its surroundings, the ground resistivity was ultimately low to obtain the necessary potential difference at the potential electrodes. So it was felt necessary to increase the sending current to raise the accuracy of the measurement, but the capacity of the transmitter is limited. Then, the grounding resistivity of the current electrodes had to be decreased by putting 2 - 3 additional pits and setting several copper electrodes with them to secure the necessary current for the measurement.

2-4-4. Wire setting

The location of the transmitter was selected as much apart from the survey line as nearly 150 m rectangularly to it, and the electric wires were taken care to be kept in the right angle to the survey line especially within five meters of it. The reason is to reduce the errors in measuring caused both by the electromagnetic coupling among the wires and the leakage current.

2-4-5. Arrangement of the instruments

The instruments were arranged in the following ways for the better efficiency of the wire setting and the measurement;

(1) The survey lines were divided into shorter spans of about 2 km.

(2) At around the center of the divided line, the transmitter was set, then sent the current for the designated current electrodes by the instruction of the receiver which gradually shifting on the line to

cover all the measuring points concerned.

(3) The receiver, accepting the artificial potential affected by the current, measured the differential potential between a couple of electrodes.

(4) The transmitter and the receiver moved to the next span as a set after completing the scheduled measurement.

2-4-6. Potential electrodes

Three pieces of nonpolarizing electrode pots made of plastic were used.

One of them was set at the center, close to the receiver, and others were arranged at 100 m apart from it, one in the front and another at the back of the first one in order to raise the measuring efficiency by reducing the time for the shifting the location of the receiver.

The bottom of the pot is sealed with a piece of thick cloth to let the saturated copper sulphate solution seep out gradually.

2-5. Analytical procedures

2-5-1. Presentation of the results

The results of the measurements have been presented in the following manners :

(1) The IP parameters, AR, FE, MF are plotted at the intersections of the 45° lines joining the mid-points of the dipoles.
Where, AR stands for the apparent resistivity value measured under the higher frequency, $AC_2$ (2.5 cps), FE being expressed

in percentage of the difference of resistivities, between under 2.5 cps and 0.3 cps, divided by the apparent resistivity measured with higher frequency $AC_2$ (2.5 cps), and MF represented by the one hundred times of devident of the frequency effect by the apparent resistivity.

The relations are as shown below:-

$$AR = \rho Ac_2$$
$$FE = (\rho Ac_1 - \rho AC_2) \div \rho Ac_2 \times 100\%$$
$$MF = FE \times 10^2 \div \rho Ac_2$$

In case of prominent portions in large scale, especially steeper slopes, the corrections have been done on topography by means of a computor.

The typical portions on the survey lines, No. 22 and No. 25 are shown on the profiles, PLII-6-11 (A) and II-6-14 (A) for the sake of reference with both respective values of AR and MF of before and after the correction.

Through these procedures, AR, FE and MF profiles of each surveyed lines have been made first in the scale of one to five thousand, then AR, FE and MF being compiled respectively in one to ten thousand as panel diagrams.

These diagrams are useful in understanding the relations among the survey lines.

In additions, plan maps on each level of 0m - 100m and - 200m in altitude have been made also in the scale of one to ten thousand after the panel diagrams. (PLII-5-1 - II-5-9)

2-5-2. Simulation

In the analyses of the underground geological structures in the simulation by the computer system, an anticipated block model of the underground geology has been expressed based on the measured points, which reflect the geological structure, in consideration of the results from the geological reconnaissance and the core logging. Then on the model, the AR and FE values of each corresponding point to the dipole-dipole position are calculated by the computer.

Comparing the values and their distribution patterns obtained from the block model with those from the field survey, the simulation has been repeated to modify the block model until the most probable one is obtained by means of trial and error.

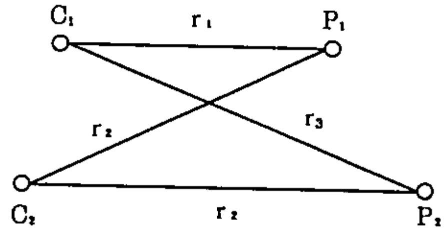
In correcting the model, the standard patterns of simulation have been used, which being compiled systematically through case histories.

In practice, the calculated values of AR and FE are separately plotted on the profile concerned and distinguished by the selected contour lines.

The patterns of these contour lines are correlated to those observed in the field survey.

Usually, the patterns of FE are used more often in priority than those of AR, because FE values reflect the presence and intensity of the underground electronic conductive minerals better and more directly. AR patterns are generally used as auxiliary means.

2-5-3. Calculation of resistivities




The equation of AR under the general electrode configuration, as illustrated, can be introduced as follows:-

$$\rho = 2\pi\left\{\left(\frac{1}{r_2}-\frac{1}{r_1}\right)-\left(\frac{1}{r_4}-\frac{1}{r_3}\right)\right\}^{-1}\times\frac{V}{I} = 2\pi K\cdot\frac{V}{I} \quad \cdots\cdots\cdots\cdots (1)$$

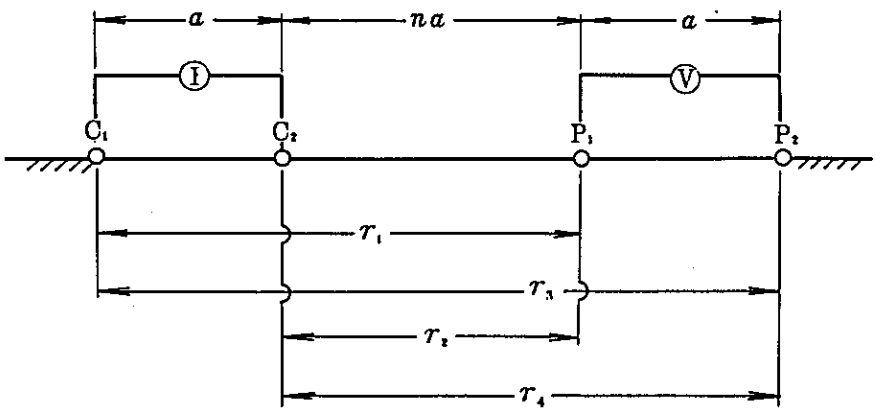
where, $\rho$ : apparent resistivity

V : received potential

I : transmitted current

$r_1$ , $r_2$ , $r_3$ , $r_4$ : distances among electrodes

In the present survey, the electrodes are arranged straightly in a line with equal intervals among them, so the calculation becomes as simplified as explained below:-




The constant K in the equation (1) can be simplified as much as shown in the following:-

$$K = \{ (\frac{1}{r_2} - \frac{1}{r_1}) - (\frac{1}{r_4} - \frac{1}{r_3}) \}^{-1}$$

$$= \{ \frac{1}{a} (\frac{1}{n} - \frac{1}{n+1} + \frac{1}{n+2} - \frac{1}{n+1}) \}^{-1} = (\frac{2}{a.n(n+1)(n+2)})^{-1}$$

Then the equation for resistivity becomes;

$$\rho = 2\pi a \cdot \frac{n(n+1)(n+2)}{2} \cdot \frac{V}{I} = \pi a n (n+1)(n+2) \frac{V}{I} = K' \frac{V}{I}$$

Where, K' varies according to the change of the separation factor N into 1, 2, 3 and 4.

Then it is rather convenient to calculate the individual AR by the use of the pre-calculated coefficient of K'.

Electrode interval "a" is chosen as 100 m in the present survey, so the constant K' becomes as follows depending on the factor "n",

$K'_{n=1}$ = 1,884

$K'_{n=2}$ = 7,536

$K'_{n=3}$ = 18,840

$K'_{n=4}$ = 37,680

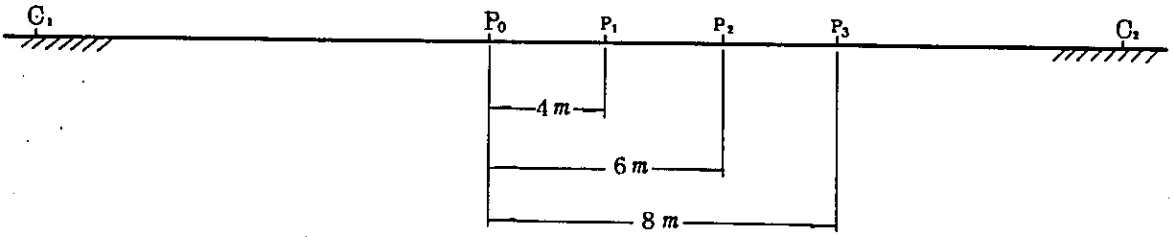
2-5-4. In-situ and sample measurement

Beside the ordinary field survey, two determinations on IP have been carried out to obtain the data on geophysical preperties of the underground to refer to the structural analysis.

The in-situ measurement on the representative rock exposures has been done with potential electrode intervals as short as from two meters to ten meters.

Also in the laboratory, AR and FE values have been tested on the typical rock specimens, collected in the field and trimmed to approximately 2cm x 4cm x 6cm in dimensions.

For reference, the electrode configuration in the in-situ measurement is shown below,




where,

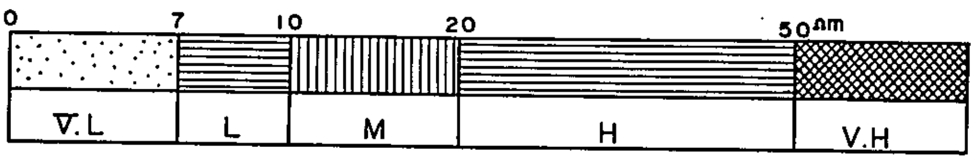
$C_1$, $C_2$ : Current electrodes (200 m apart from each other)

$P_0$, $P_1$, $P_2$, $P_3$ : potential electrodes ($P_0 : P_1$, $P_0 : P_2$, $P_0 : P_3$ in combinations)

Chapter 3 Details of IP Survey

## 3-1. Results on AR

(1) In analyzing the data, the values of the apparent resistivity are grouped into five stages such as very high (VH), high (H), medium (M), low (L), very low (VL), and it is presumed that in the true resistivity of the underground media, there are the same five stages of relative resistivity values, corresponding to the former ones.




Then, the distributions of the AR can be supporsed to be proportional to the resistivity of the underground media, because the AR is always the reflection of the resistivity of the media. Here, the medium restivity from 10 to 20 m is thought as the background resitivity of the area.

(2) The In-situ measurement of the AR and FE values of the grounds has been carried out at thirty nine locations mostly on and around the Letpadaung hill, and seven rock samples picked from the field have been measured in the laboratory to obtain informations for the structural analysis. Those data are shown in Table II-1.

(3) In reviewing all the survey results, the following items can be introduced :

1) The very low resistivity zone with AR below 7Ω-m distributes mostly in a large area spreading from the northwestern Letpadaung hill to the outernal plain in the southeast.

In the closest west of the very low resistivity zone, there is a high resistivity zone which surrounds very high resistivity portions. (PLII-2-1 ~ II-2-12, PLII-5-1 ~ II-5-3)

2) Hills at Let padaung, Taungzone, Shwebontha, etc. have been found as high resistivity zones of over 30Ω m situating generally in the outskirt of the above introduced very high resistivity portions.

In their vicinities, high resistivity zones, inferred to be their extensions or their surroundings, have been widely observed. And also around the E-gon village in the south of Kyaukmyet, a large high resistivity zone has been found, but it changes gradually into a medium resistivity zone in the deeper portion. The eastern plain of the Letpadaung hill has been detected as a medium resistivity zone, which may have been caused by a thick recent sediments covering the area.

In addition, a high resistivity zone is also found in the northeast of the former.

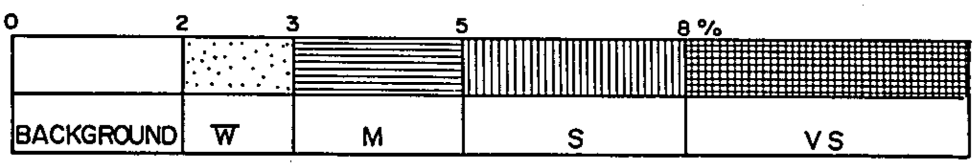
3) In general, the elongation of the detected low resistivity zone, which is inferred to suggest the trend of the mineralized alteration zone in the Letpadaung sector, has been proved as of NW to SE direction.

The trend of the medium to low resistivity zones, found in and around the ore doposits in Kyisindaung and Sabedaung sectors, is also the same direction of NW to SE, though the Letpadaung zone is supposed to situate a little to the west of the echeron like structure.

4) The southern boundary of the mineralization and alteration in the Letpadaung sector has been presumed to reach the vicinity of the line No. 28 as far as the reading of AR values is concerned.

3-2. Results on FE

(1) In analyzing the data, the values of the frequency effect are grouped into four stages such as very strong (VS), strong (S), medium (M), and weak (W), and compared each other for their interpretation.




(2) Simultaneously as with AR, in-situ measurement for thirty-nine stations and a laboratory measurement for seven rock-samples have been accomplished with frequencies, 2.5 cps and 0.3 cps. The measured FE values are as shown in the attached table. (Table II-1)

(3) In reviewing all the survey results of FE on the attached maps (PLII-5-4 ~ II-5-6) and panel diagrams (PLII-2-5 ~ II-2-8), a large and strong FE anomaly can be observed mainly on the northern and eastern slope of the Letpadaung hill and its extended

flat plain.

It distributes on the marginal and outernal part of the silicification zone which forms the prominent portions of the Letpadaung hill with some exceptions. And it can be summarized of its lateral extension as about 4.5 km in east to west direction, and around 2 km in north to south direction.

On the contrary, the main ridges in the northwest and southeast of the Letpadaung hills seldom accompany FE anomalies. Exceptionally in such localities as a part of the valley with a monastery between the abobe-mentioned two ridges and a part of the southern slope of the southeastern mountain block, a little stronger FE anomalies have been detected, though they are not large in scale.

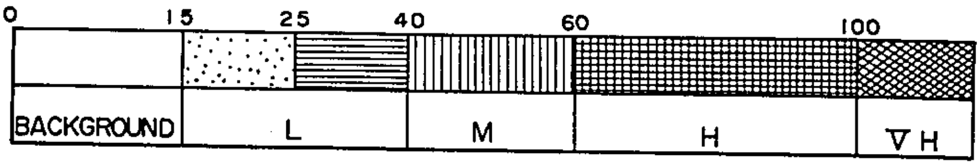
The described large main FE anomaly has been also recognized to have a tendency of FE becoming stronger and wider in the deeper portion, and the strong anomaly is surrounded by the weaker anomaly of 2% to 3% in FE.

The weak anomaly probably continues to the Kyaukmyet anomaly caught in phase I in the depth in the north, and may extend widely to Sede village and Salingyi road.

Other places, Taungzone hill, Shwebontha hill, etc. which were once expected to bear strong IP anomalies in planning, have been found not promising because of the scarcity of FE anomaly.

3-3. Results on MF

(1) In analyzing the data, the values of the metal conduction factor are grouped into four stages such as very high (VH), high (H), medium (M), low (L), and compared each other for their interpretation.




(2) In reviewing the results (PLII-5-7 ~ II-5-9), the higher MF zone can be observed in a large mass on the wide ridges and foot plains of the northerly Letpadaung hill, especially from its northwestern end to its east side. The eastern end of it reaches the vicinity of the highway to Salingyi.

In other words, from east to west for about 4.5 km between the line No. 18 and No. 28, there has been found a high to medium MF zone which has a very high MF zone over 100 in MF value in its core no other special MF aomaly has been detected in the present survey.

In the mean time, MF is calculated in dividing FE by AR after multiplying the coefficient of 100 to AR because of the low regional ground resistivity. Thus MF, in a sense, expresses the IP anomaly for it is doubly affected by AR and FE, because the ground with conductive minerals in generally high in FE and low in AR.

Then, MF can be used effectively in the interpretation of the detected anomaly where the AR being less affected by the topography and the background homogeneous in resistivity in the surveyed area. In other words, attentions should be paid for such MF values that have been detected in the area of FE values below 3%, for they might show a mock anomaly based on only low resistivities in stead of a real MF anomaly based on high FE values. The horizontal shape of the block has a smoother face toward north and east, and in opposite direction to southwest it looks an uneven fork face because of the very low MF zone observed in the southwestern part of the high ridges locating in the south of the central valley of the Letpadaung hills.

On other hands if looked limitedly on the shallower level of about 100m in depth from the flat surface, the higher MF distribution can be observed restrictively in the following three districts;

1) Northern slope of the northern block of the Letpadaung hill and its eastward extension
2) Vicinities of the northeastern end of the southern block of the hill
3) Surrounding district of the monastery in the central valley of Letpadaung

## Chapter 4 IP characters compared with the natures of rock and ground concerned

### 4-1. In-situ and sample measurements on IP

The 39 locations of in-situ measurement on IP are shown in the General Explanation Map (PLII-1-2), and their results are illustrated as in the Table II-1, "in-situ & Laboratory IP Values".

In general, the results of in-situ measurement can be appreciated higher in credibility, because the in-situ measurement is usually investigated directly on the exposed rock or some exposed ground to measure its AR and FE with potential electrode intervals of 4 to 8 meters.

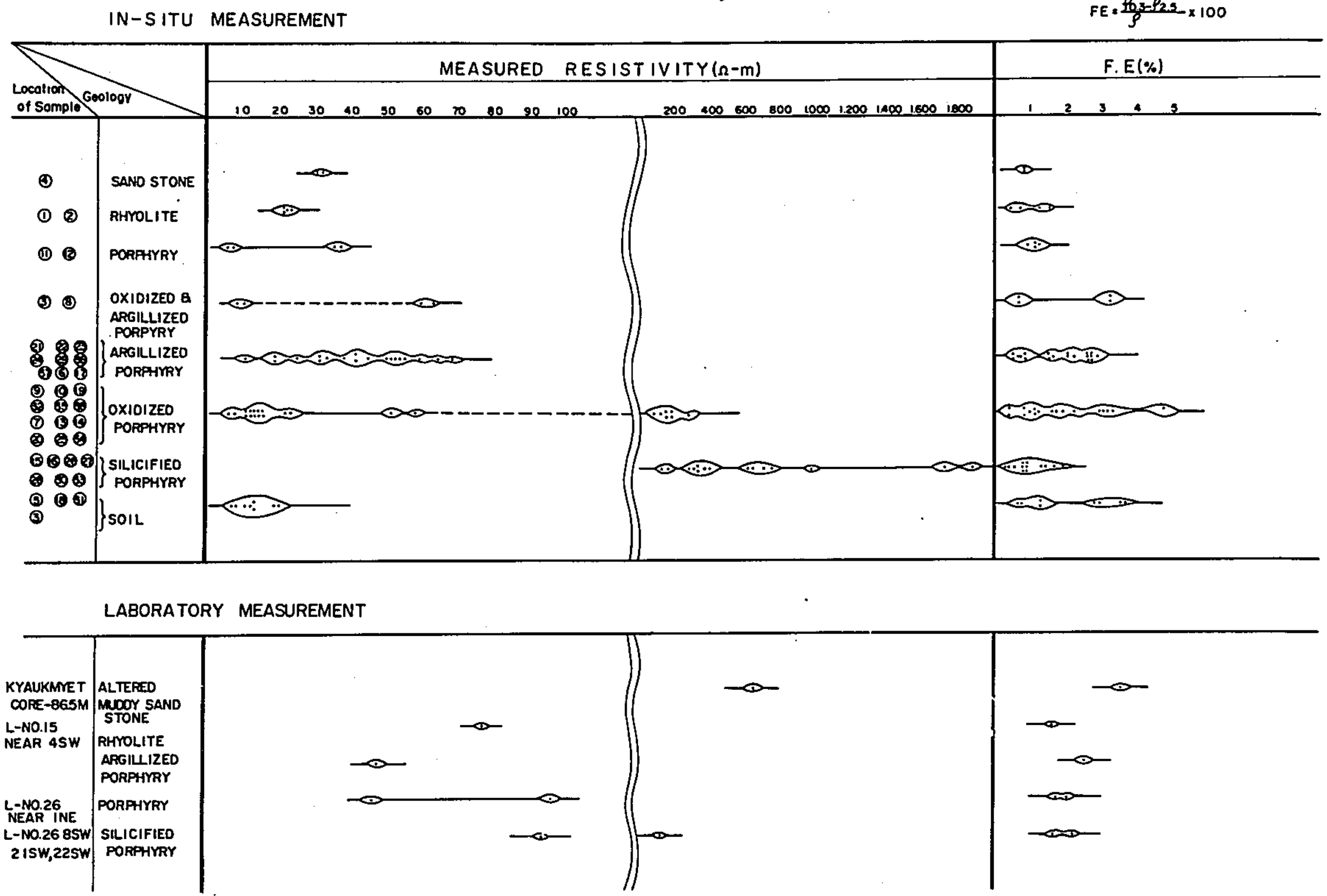
From the Table II-1, it is easily understood that each measured value by in-situ keeps higher tendency especially in AR. There are some wide variations in the measured values even in the common formation classified as of the same rock in comparison with the results from the ordinary field survey with electrode interval of 100 m and electrode-separation factors of one to four.

For instance, AR values widely vary from 10Ω-m to 70Ω-m in case of the argillized porphyry, and also vary in three ranges such as from 6Ω-m to 23Ω-m, 51Ω-m to 58Ω-m, and 140Ω-m to 280Ω-m in the oxidized porphyry.

These results may be suggesting that there is a wide variation electrically even in the case when they are classified as the same rock from their resembling appearance in the field survey.

The silicified porphyry has shown so high relative resistivities as

## Table II-1 In-Situ & Laboratory Measurement on AR & FE



from 133Ω-m to 1, 888Ω-m.

On FE, most of the results are below 3%. Those over 3% in FE have been recognized only in the oxidized and argillized porphyry oxidized porphyry, and some parts of the overburden soil.

None has been detected in the measurement that exceeds 5% in FE.

These results of lower FE presence may be explained in a way that the main FE-causing pyrite seeps down into the lower level after being decomposed by weathering and leached, and remains little near the surface.

In the above explanation, the porphyry has been classified, for convenience, into the four categories such as the following and they have been divided by the criteria which are also shown below;

(1) Oxidized porphyry

heavily oxidized and leached perphyry, and characterized with vuggy appearances.

(2) Argillized porphyry

characterized by the argillization a companying, kaoline etc.

(3) Oxidized & argillized porphyry

characterized by the mixture of vuggy silicified porphyry and clayey porphyry.

(4) Silicified porphyry

characterized by silicification with fading colours of mafic minerals into milky white.

In addition for the sake of comparison with in-situ results, 7 pieces of rock specimens have been measured on AR and FE in the laboratory, and their results are shown on the same table.

4-2. Vertical electric sounding (Schlumberger)

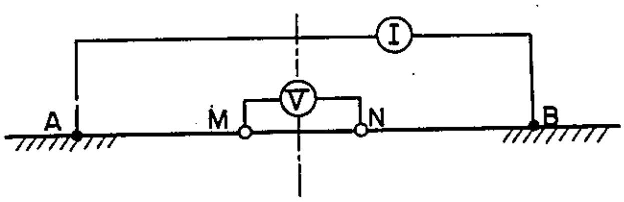
In order to obtain a technical information useful for the interpretation of the dipole-dipole survey results, the Schlumber's method of vertical electric sounding was applied for the 2 locations on the IP survey line No. 17, stations of 19 SW and 20 SW being selected as the mid-points of the electrode configurations respectively.

And the thickness and the depth of the underground structures below these stations have been inferred through curve matching etc.

These stations were selected for the mid-points because of the following reasons;

(1) On surface the topography is flat and a horizontal structure has been assumed geologically around the stations.

(2) The location has been surveyed by dipole-dipole method beforehand, and the observed low AR and high FE can be used for the comparison conveniently.




In the field survey, the electrode configuration has been symmetrically arranged in setting the mid-point at the center as shown in the illustration, and after the potential electrodes MN being fixed temporarily, the underground relative resistivities have been measured by sending the necessary current to the current electrodes A, B which were chosen in the following range in connection with the potential electrodes M, N;

$$\frac{\overline{AB}}{2} < (25 \simeq 5) \times \frac{\overline{MN}}{2}$$

Both $\overline{MN}$ and AB have been gradually enlarged to measure the deeper portions in the field.

MN, AB were arranged on the line No. 17, and the distance of AB/2 was chosen from 10m to 800m in order to investigate the ground down to 300m in depth from surface, because geologically from surface to 30m, at most 50m, the weathered zone had been supposed, then changing into the secondary enriched zone down to 100m, at most 150m. Below the secondary enriched zone, the primary zone had been also anticipated.

Fig. II-2 shows the Vertical Electric Sounding (hereafter called as VES) curves in which the results of the measurement are expressed in logarithmic graphs.

Here, the relative resistivity has been calculated in the following formula.

$$\rho a = \frac{\pi}{4} \frac{(\overline{AB})^2 - (\overline{MN})^2}{\overline{MN}} \frac{V}{I} = K \frac{V}{I} \quad (\Omega\text{-m})$$

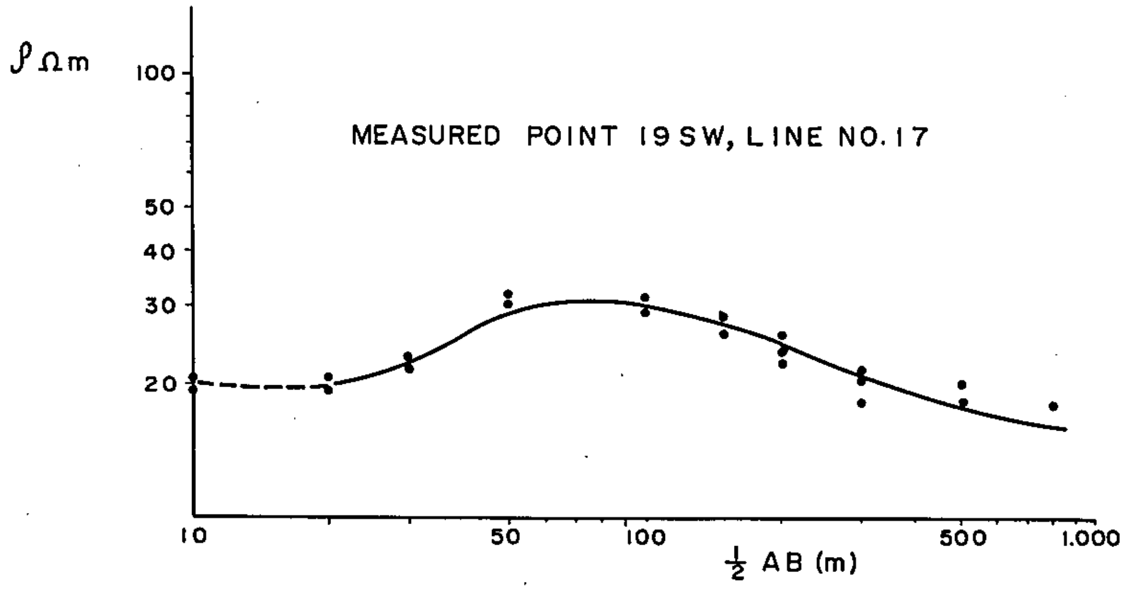
Then, the constant K is expressed as,

$$K = \frac{\pi}{4} \frac{(\overline{AB})^2 - (\overline{MN})^2}{\overline{MN}}$$

0.3 cps was selected as the basic frequency for the measurement, because it affects little on electromagnetic coupling.

Under the assumption that the underground consists of a horizontal

Fig. II-2 Vertical Electric Sounding Curves (Schlumberger's)



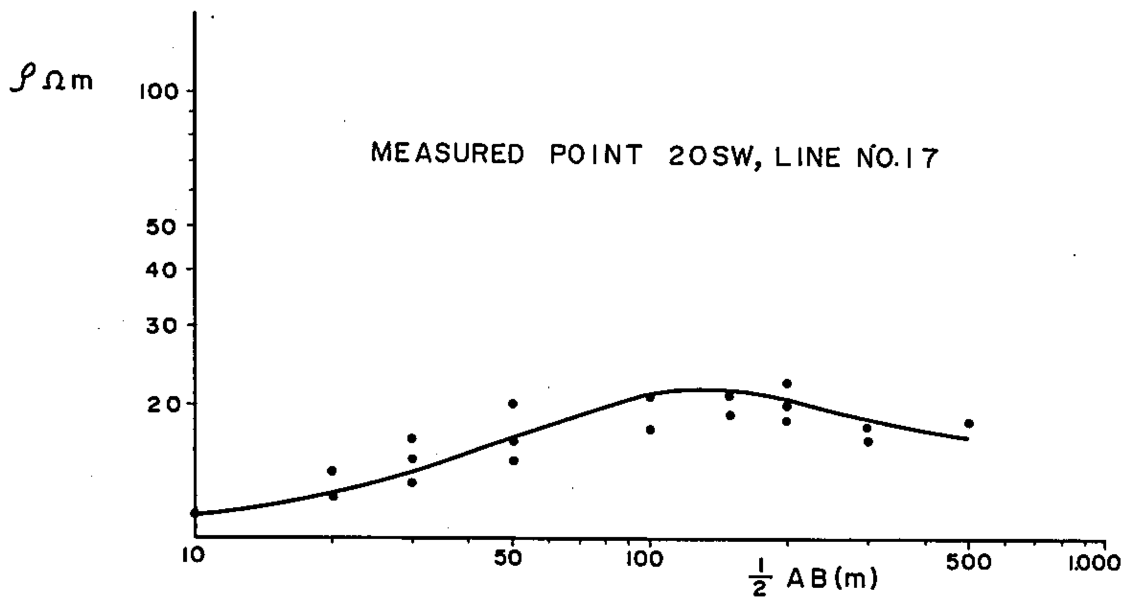



Fig. II - 2 (A) Vertical Sounding Data

Measured Point 19 SW Line No. 17

| MN | AB | K | I | V | $\rho_a$ |
|---|---|---|---|---|---|
| 4 m | 20 m | 75.3 | 1,800 mA | 492 mV | 20.6 Ω-m |
| " | 40 | 311 | 1,300 | 80.3 | 19.2 |
| " | 60 | 703 | 1,800 | 50.6 | 21.7 |
| 6 | 40 | 204 | 1,300 | 130.5 | 20.5 |
| " | 60 | 468 | 1,800 | 88.2 | 22.9 |
| " | 100 | 1,300 | 1,500 | 36.3 | 31.5 |
| 10 | 60 | 274 | 1,700 | 137 | 28.2 |
| " | 100 | 777 | 1,500 | 59.1 | 30.6 |
| " | 200 | 3,130 | 2,000 | 19.9 | 31.2 |
| 20 | 100 | 376 | 1,400 | 12 | 30.0 |
| " | 200 | 1,555 | 2,000 | 38.8 | 30.1 |
| " | 300 | 3,510 | 1,800 | 14.6 | 28.6 |
| " | 400 | 6,260 | 2,500 | 10.2 | 25.5 |
| 40 | 300 | 1,735 | 1,800 | 27.0 | 36.0 |
| " | 400 | 3,100 | 2,500 | 18.7 | 23.1 |
| " | 600 | 7,030 | 2,500 | 7.48 | 21.3 |
| 60 | 400 | 2,040 | 2,500 | 27.3 | 22.6 |
| " | 600 | 4,680 | 2,500 | 11.1 | 20.7 |
| " | 1,000 | 13,000 | 2,500 | 3.88 | 20.2 |
| 100 | 600 | 2,740 | 2,500 | 16.7 | 18.4 |
| " | 1,000 | 7,770 | 2,500 | 6.29 | 18.2 |
| " | 1,600 | 20,000 | 2,500 | 2.28 | 18.2 |

Fig. II - 2 (B) Vertical Sounding Data

Measured Point 20 SW Line No. 17

| MN | AB | K | I | V | $\rho_a$ |
|---|---|---|---|---|---|
| 4 m | 20 m | 75.3 | 1,700 mA | 252 mV | 11.2 Ω-m |
| " | 40 | 311 | 1,800 | 72.2 | 12.5 |
| " | 60 | 703 | 1,800 | 34.4 | 13.4 |
| 6 | 40 | 204 | 1,700 | 117 | 14.0 |
| " | 60 | 468 | 1,800 | 57.5 | 15.0 |
| " | 100 | 1,300 | 1,800 | 20.8 | 15.0 |
| 10 | 60 | 274 | 1,800 | 110.0 | 16.8 |
| " | 100 | 777 | 1,800 | 31.1 | 16.8 |
| " | 200 | 3,130 | 2,000 | 11.2 | 17.6 |
| 20 | 100 | 376 | 1,800 | 96.4 | 20.1 |
| " | 200 | 1,555 | 2,000 | 26.8 | 20.8 |
| " | 300 | 3,510 | 1,800 | 9.80 | 19.1 |
| " | 400 | 6,260 | 2,000 | 5.84 | 18.2 |
| 40 | 300 | 1,735 | 1,800 | 21.8 | 21.0 |
| " | 400 | 3,100 | 2,000 | 13.2 | 20.3 |
| " | 600 | 7,030 | 2,000 | 4.37 | 26.7 |
| " | 400 | 2,040 | 2,000 | 21.9 | 22.3 |
| " | 600 | 4,680 | 2,000 | 7.59 | 17.8 |
| " | 1,000 | 13,000 | 1,800 | 2.55 | 18.3 |
| 100 | 600 | 2,740 | 2,000 | 13.0 | 17.8 |
| " | 1,000 | 7,770 | 1,800 | 4.22 | 18.2 |
| " | 1,600 | 20,000 | 2,000 | 1.94 | 19.4 |

seam structure, the VES curves were analyzed with the Schlumberger's standard curves and Ono's auxiliary interpretation curve. The following is the result of the study.

| Midpoint | 19 SW | | 20 SW | | Remarks |
|---|---|---|---|---|---|
| | Thickness | Relative R | Thickness | Relative R | |
| First layer | 20 m | 18.5 Ω-m | 17 m | 11.0 Ω-m | Weathered zone |
| Second " | 5 m | 55.5 " | - | - | Secondary enriched zone |
| Third " | 61 m | 32.4 " | 55 m | 27.5 " | |
| Fourth " | | 15.5 " | | 15.5 " | Primary zone |

In checking the VES curve of 20 SW, the variation of the relative resistivity can be found large in widening the intervals of the potential electrodes.

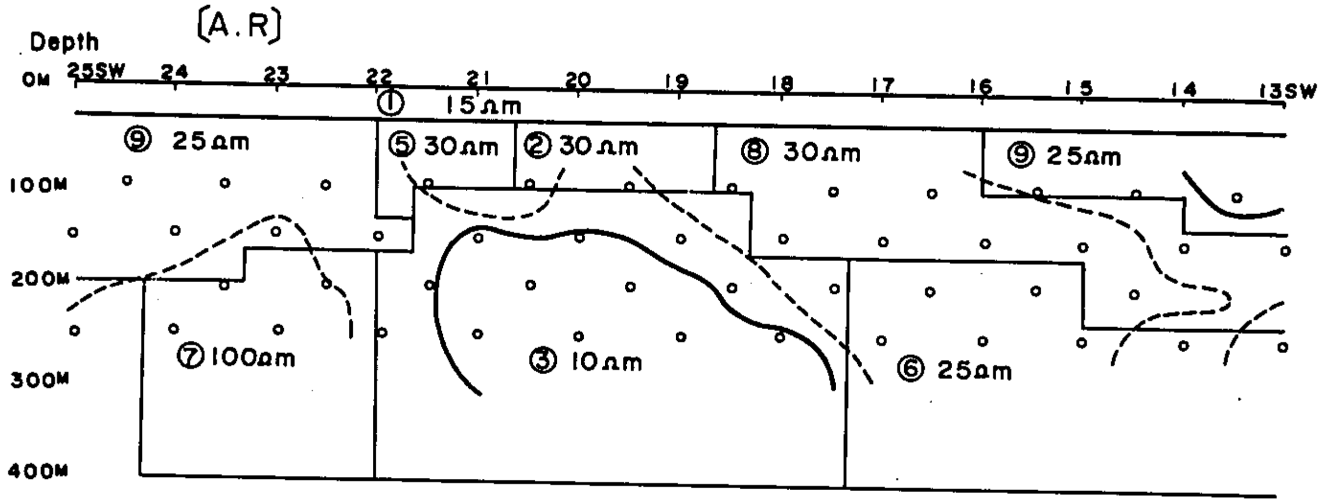
From the wide variation, the actual underground structure may be inferred not so horizontal as assumed theoretically.

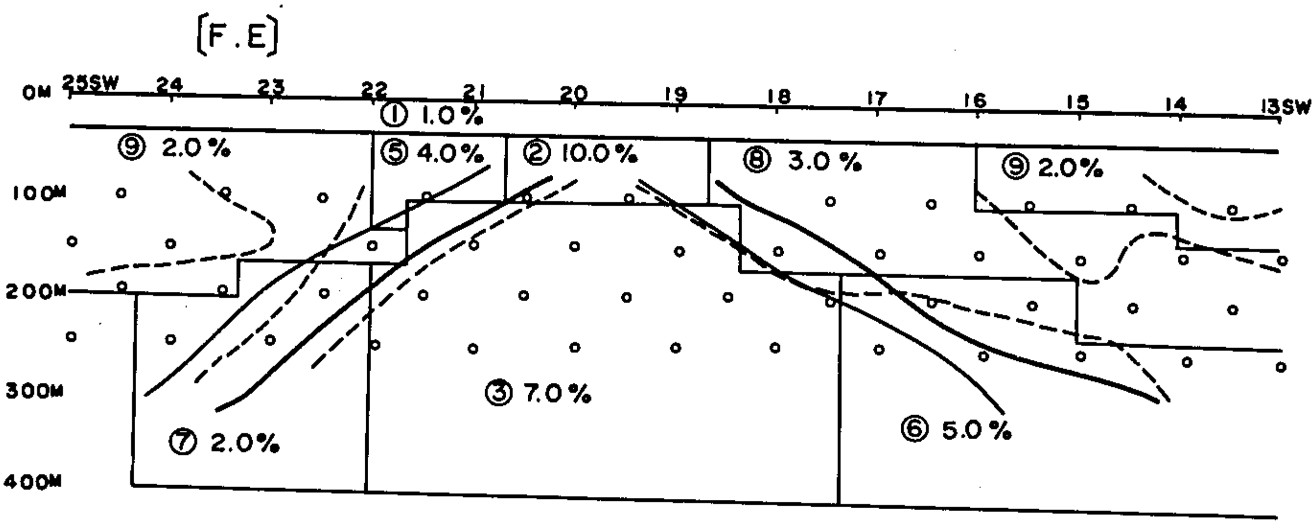
The result of the simulation study of the underground structure in consideration of the vertical sounding results is shown in Fig. II-3.

In the figure, the field measured patterns of AR and FE by dipole-dipole method are also illustrated.

Of these, especially on relative resistivity, though the simulation was done with lower relative resistivity values than those obtained from the vertical sounding, after considering that the relative resistivity of the near-surface portion affects much to that of the lower portion in dipole-dipole arrangement, a AR pattern

Fig. II-3 IP Simulation Results after Vertical Sounding



similar to the field measured pattern has been obtained.
From this fact, it can be inferred that the higher resistivity in Schlumberger's method has been observed by the influences of the higher resistivity bodies on both outernal sides in southwest and northeast of the mid-points at 19 SW and 20 SW as shown in the underground block models.
And in Schlumberger's method, when the first layer is low and the second layer high each in resistivity, the current flows more in the first layer and less for the third and fourth layers because of the worse penetration of the current caused by the second layer. In this case, the accuracy of the analysis may become lower especially in the third and fourth layers. Though, FE has foundamentally no relation with the vertical sounding, the simulation has been done on FE assumed for the underground structural model above mentioned.
Then the FE pattern has been obtained, which resembles the pattern after the field FE measurement. From the result, a strong FE response body can be designated in the second layer (in case of 19 SW, in the second & third layer), and a less strong FE response body in the third layer (in case of 19 SW, in the fourth layer) can be visualized.
The correlation of the relative resistivities have been undertaken on the basis of 0. 3 cps.
Through the vertical sounding, especially the extent of the resistivity and the thickness of the horizontal layer near surface

have been surveyed and expressed more precisely than in the results of measurement in dipole-dipole method.

But, for a regional geophysical reconnaissance, dipole-dipole method is believed better fit, because of its efficient performance. So the vertical sounding will be desirable to be applied auxiliarily for 2 to 3 points selected on each survey line, when it is necessary to ensure the interpretation of the survey results.

4-3. Electromagnetic coupling effect

Electromagnetic (hereafter, EM) coupling effect has been tested in the south east of Letpadaung hill, where a low resistivity range found in phase II survey with medium intensity in FE spreads widely on the flat plain.

A part of the line No. 28 between 4 SW and 12 NE was selected for the study, because it is fit for the later correlation for both its comparatively horizontal and long lateral distribution of FE under the flat topography as seen on the FE panel diagram, and the fewer variation of AR value. With the new combination of the frequencies of 0.3 cps ($AC_1$) and 1.25 cps ($AC_2$), the line was remeasured.

And from the newly surveyed FE (1.25/0.3) and the ordinary FE (2.5/0.3), demasked of FE and MF both on the coupling have been theoretically calculated, and shown in Fig. II-4 (⑤ & ⑥).

In order to disclose the general tendency in demasking the coupling effect and in the coupling itself, the measuring points of the line were divided, on Fig. II-4 ① into 8 groups by 2 ways.

Fig. II-4-1 EM Coupling Test Results

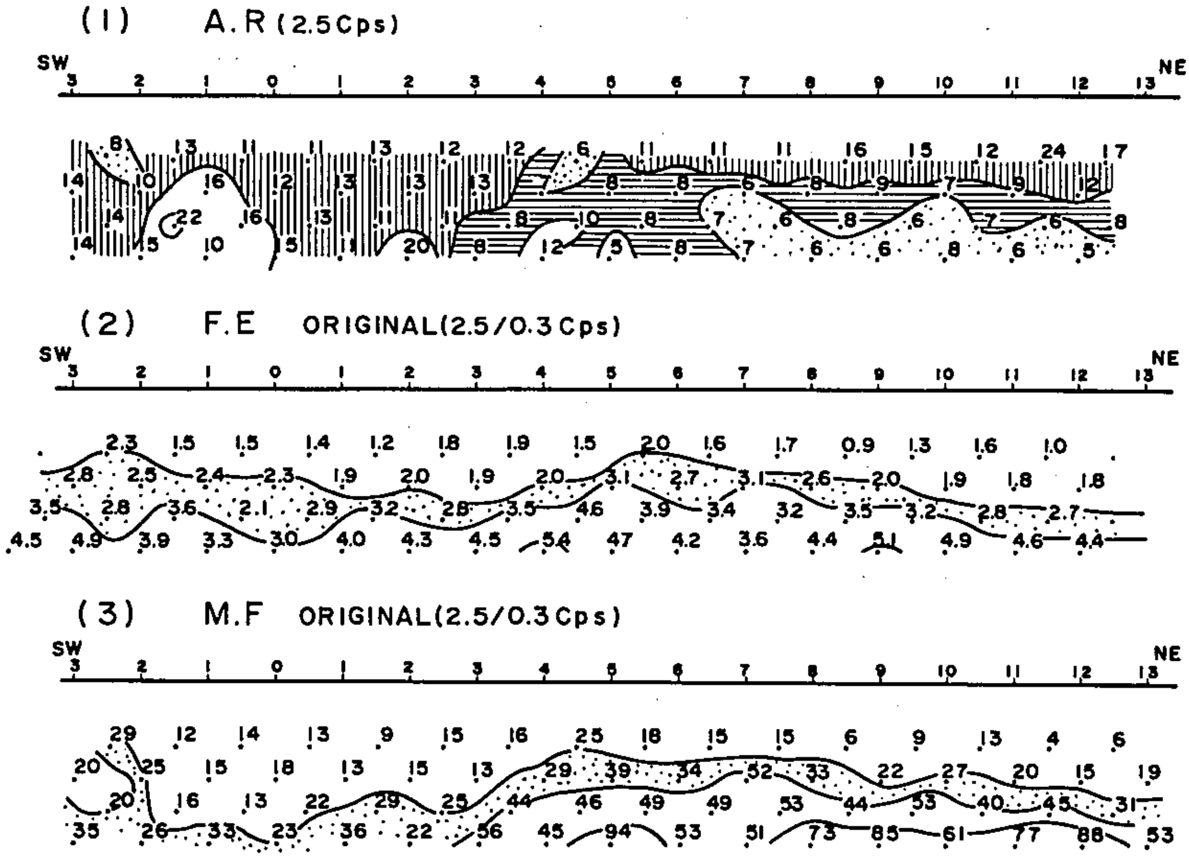
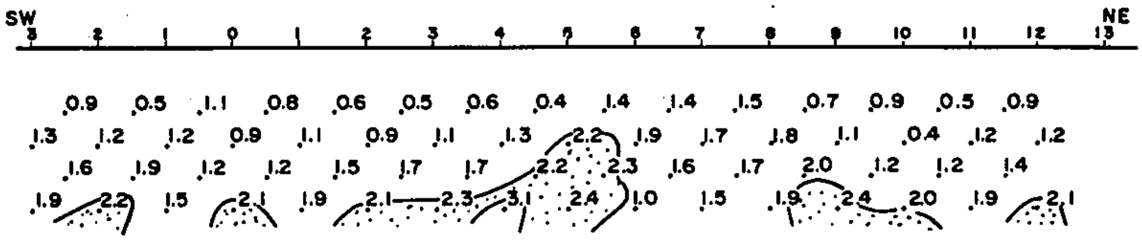
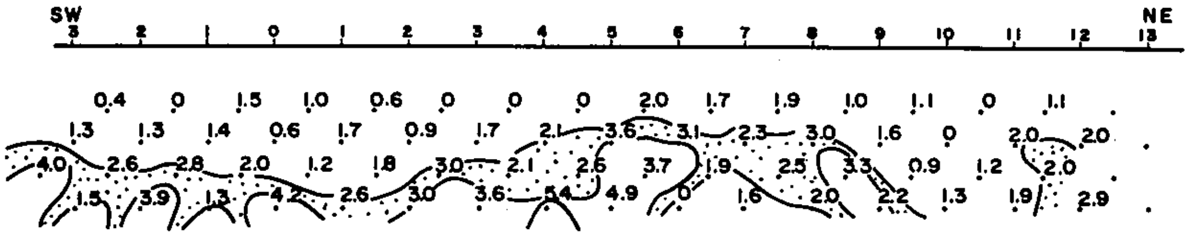


Fig. II-4-2 EM Coupling Test Results

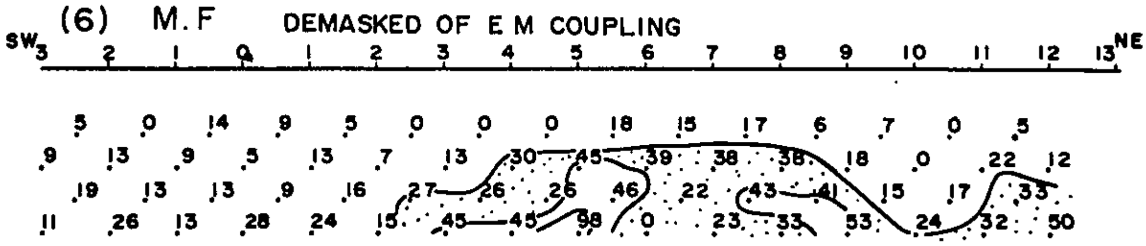
(4) F.E REMEASURED(1.25/0.3 Cps)




(5) F.E DEMASKED OF EM COUPLING




(6) M.F DEMASKED OF E M COUPLING



One is by laterally according to the extent of the relative resistivity, that is 26 points with higher resistivity in the southwestern side of the station 3 NE into A group, and 38 points with lower resistivity in the northeastern side of 3 NE into B group.

Another way is by the depth of the points such as minus 100 m, 150 m, 200m, and 250 m respectively.

In analyzing the results how AR and FE change before and after the deamsking of the coupling effect in these 8 groups, the following facts have been understood (Fig. II-5);

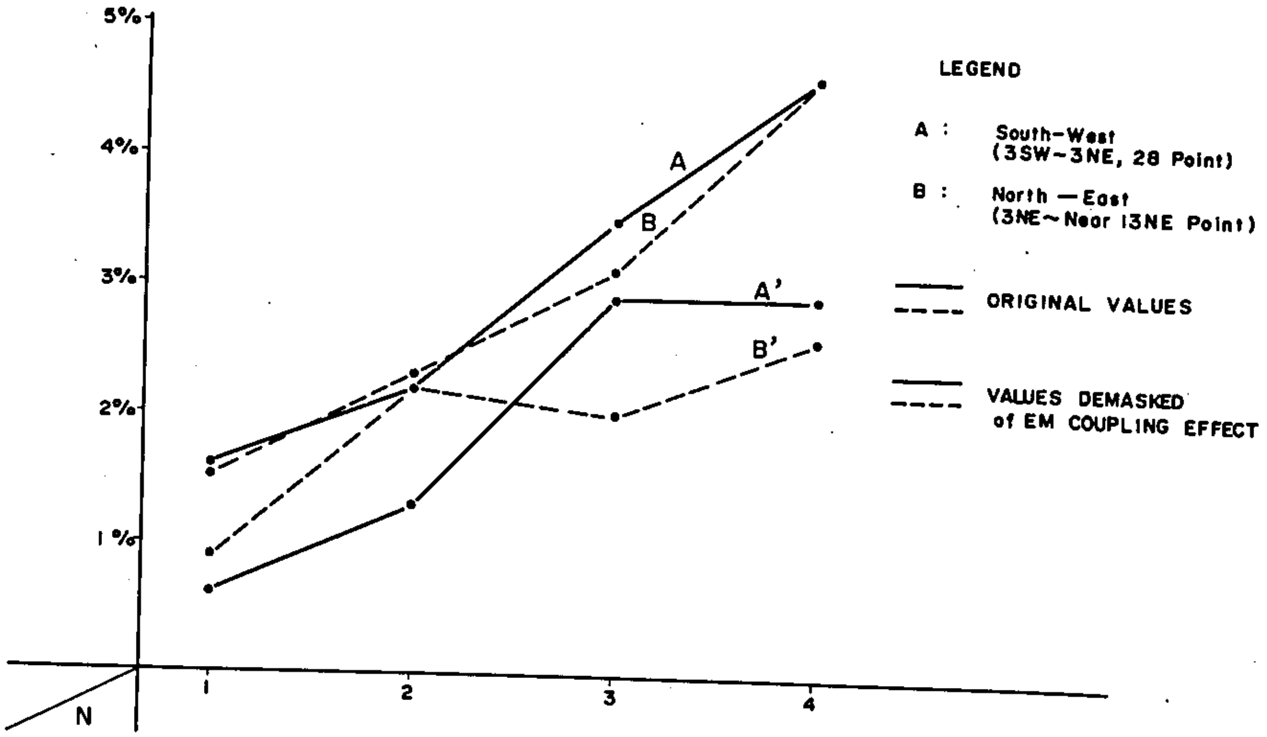
(1) EM coupling has been observed on each points, and by excluding its effect, FE decreases into about 70% of the ordinary measured FE in arithmetic average.

(2) As anticipated beforehand that the EM coupling effect might be bigger in the lower resistivity portion, the FE decrease has been proved bigger in the lower resitivity portion in the northeastern zone especially below -200m (N=3).
FE has decreased into about 60% of the original value after getting rid of the coupling effect in the northeastern deeper zone (N = 3, 4), where lower resistivities were observed.

From these, it can be mentioned that the strong FE anomaly zone observed in this region in a deep portion, especially in case of being overlapped by a low relative resistivity zone, shows itself exaggeratedly wider in its distribution than it does in a mountaineous range where there is no low resistivity zone on around the surface.

So it is necessary to pay attention for the treatment of the higher

Fig. II-5 Comparison of FE Values




FE Variation in Removing EM Coupling Effect

| | South West Side | | | | | North East Side | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Original | | Without Coupling | | Balance | Original | | Without Coupling | | Balance |
| N = 1 | 1.6 % | - | 0.6 % | = | 1.0 % | 1.5 % | - | 0.9 % | = | 0.6 % |
| 2 | 2.2 " | - | 1.3 " | = | 0.9 " | 2.3 " | - | 2.2 " | = | 0.1 " |
| 3 | 3.5 " | - | 2.9 " | = | 0.6 " | 3.1 " | - | 2.0 " | = | 1.1 " |
| 4 | 4.6 " | - | 2.9 " | = | 1.7 " | 4.6 " | - | 2.6 " | = | 2.0 " |

FE Decreasing Ratio in Removing EM Coupling Effect

| | South West Side | North East Side |
|---|---|---|
| | Without Coupling/Original x 100% | Without Coupling/Original x 100% |
| N = 1 | 37.5 % | 60.0 % |
| 2 | 59.0 " | 96.0 " |
| 3 | 83.0 " | 64.4 " |
| 4 | 63.0 " | 56.4 " |

FE observed in the deeper portion where a low resistivity zone is distributed near the surface.

But the above mentioned relations are all calculated theoretically under the assumption that the underground media being homogeneous, then the practical correction method of the FE values needs further studies for its general application.

## 4-4. FE effects and Assay results of core samples from IP checking drill holes

In the conclusion of the geophysical survey of phase I, the following three holes for three IP anomalies were recommended,

| | | | |
|---|---|---|---|
| Kyisindaung south | : | Around 4 SW on line No. 3 | 200 m |
| Sabedaung south | : | Around 9 NE on line No. 4 | 200 m |
| Kyaukmyet | : | Around 28 NE on line No. 8 | 200 m |
| | | Total | 600 m |

These recommended holes have been drilled in phase II survey to check the characters of each IP anomaly concerned.

The results of the core-assay are as shown in the tables. (Table II-2 - II-4)

On the table, attention should be paid for the location of Kyaukmyet drilling site, because the location could not but removed from 28 NE on line No. 8 to around 28 NE on line No. 9 for the proposed drill site had changed into the river-bed of Yama stream.

The copper contents of the holes were found so low as from 0.02 % to below 0.01 %, so comparison has been made on the pyrite contents after supposing all the sulphur compounded in pyrite for the

Table II-2 Assay Result of Pilot Drilling for IP Anomaly at Kyisindaung South

Hole Length 201. 0 m

| Name of Sample | Depth of Sample | Presumed Sample Length | Total Cu | Soluble Cu | S | Fe | Supposed Pyrite Content |
|---|---|---|---|---|---|---|---|
| C-911 | 20 ~ 22 m | 2. 0 m | 0. 02 % | <0. 01 % | 0. 19 % | 5. 4 % | 0. 4 % |
| " 916 | 30 ~ 32 | 1. 5 | | | 3. 46 " | 4. 3 " | 6. 5 " |
| " 921 | 40 ~ 42 | 2. 0 | | | 3. 68 " | 5. 1 " | 6. 9 " |
| " 926 | 50 ~ 52 | " | 0. 02 " | <0. 01 " | 3. 71 " | 7. 7 " | 7. 0 " |
| " 931 | 60 ~ 62 | " | | | 4. 07 " | 4. 2 " | 7. 7 " |
| " 936 | 70 ~ 72 | " | | | 0. 22 " | 5. 0 " | 0. 4 " |
| " 941 | 80 ~ 82 | " | 0. 01 " | <0. 01 " | 0. 22 " | 3. 9 " | 0. 4 " |
| " 946 | 90 ~ 92 | " | | | 2. 89 " | 4. 6 " | 5. 5 " |
| " 951 | 100~102 | " | | | 3. 55 " | 3. 7 " | 6. 7 " |
| " 956 | 110~112 | " | <0. 01 " | <0. 01 " | 0. 36 " | 3. 4 " | 0. 7 " |
| " 961 | 120~122 | " | | | 0. 14 " | 3. 1 " | 0. 3 " |
| " 966 | 130~132 | " | | | 0. 16 " | 3. 2 " | 0. 3 " |
| " 971 | 140~142 | " | <0. 01 " | <0. 01 " | 0. 16 " | 3. 7 " | 0. 3 " |
| " 976 | 150~152 | | | | 0. 18 " | 3. 5 " | 0. 3 " |
| " 981 | 160~162 | " | | | 3. 96 " | 7. 5 " | 7. 5 " |
| " 986 | 170~172 | " | <0. 01 " | <0. 01 " | 0. 70 " | 3. 5 " | 1. 3 " |
| " 991 | 180~182 | " | | | 0. 90 " | 5. 6 " | 1. 7 " |
| " 996 | 190~192 | " | | | 0. 34 " | 3. 7 " | 0. 6 " |
| " 1001 | 200~201 | 1. 0 | <0. 01 " | <0. 01 " | 0. 22 " | 3. 8 " | 4. 2 " |

Table II-3 Assay Result of Pilot Drilling for IP Anomaly at Sabedaung South

Hole Length 201. 2 m

| Name of Sample | Depth of Sample | Presumed Sample Length | Total Cu | Soluble Cu | S | Fe | Supposed Pyrite Content |
|---|---|---|---|---|---|---|---|
| C-1228 | 20 ~ 22$^{m}$ | 2. 0$^{m}$ | 0. 02% | <0. 01% | 3. 00% | 7. 1% | 5. 7% |
| " 1233 | 30 ~ 32 | " | | | 2. 70 " | 6. 7 " | 5. 1 " |
| " 1238 | 40 ~ 42 | " | | | 2. 06 " | 5. 2 " | 3. 9 " |
| " 1243 | 50 ~ 52 | " | 0. 01 " | <0. 01 " | 2. 32 " | 5. 1 " | 4. 4 " |
| " 1248 | 60 ~ 62 | " | | | 2. 94 " | 4. 5 " | 5. 5 " |
| " 1253 | 70 ~ 72 | " | | | 1. 34 " | 9. 6 " | 2. 5 " |
| " 1258 | 80 ~ 82 | " | 0. 01 " | <0. 01 " | 1. 78 " | 8. 7 " | 3. 4 " |
| " 1263 | 90 ~ 92 | " | | | 1. 07 " | 7. 5 " | 2. 0 " |
| " 1268 | 100~102 | " | | | 1. 45 " | 10. 0 " | 2. 7 " |
| " 1273 | 110~112 | " | 0. 01 " | <0. 01 " | 2. 12 " | 6. 8 " | 4. 0 " |
| " 1278 | 120~122 | " | | | 4. 06 " | 5. 3 " | 7. 7 " |
| " 1283 | 130~132 | 1. 5m | | | 2. 98 " | 8. 0 " | 5. 6 " |
| " 1288 | 140~142 | 2. 0 | 0. 01 | <0. 01 | 3. 36 " | 5. 6 " | 6. 3 " |
| " 1293 | 150~152 | 2. 0 | | | 2. 64 " | 6. 7 " | 5. 0 " |
| " 1298 | 160~162 | " | | | 1. 25 " | 6. 4 " | 2. 4 " |
| " 1303 | 170~172 | " | 0. 01 | <0. 01 " | 1. 76 " | 6. 0 " | 3. 3 " |
| " 1308 | 180~182 | " | | | 3. 85 " | 7. 4 " | 7. 3 " |
| " 1313 | 190~192 | " | | | 3. 50 " | 5. 5 " | 6. 6 " |
| " 1318 | 200~201, 2 | 1. 2 | 0. 01 " | <0. 01 | 1. 34 " | 7. 1 " | 2. 5 " |

Table II-4 **Assay Result of Pilot Drilling for IP Anomaly at Kyaukmyet**

Hole Length 200. 6 m

| Name of Sample | Depth of Sample | Presumed Sample Length | Total Cu | Soluble Cu | S | Fe | Supposed Pyrite Content |
|---|---|---|---|---|---|---|---|
| C-1319 | 50 ~ 52$^{m}$ | 2. 0$^{m}$ | <0. 01% | <0. 01% | 0. 18% | 2. 4% | 0. 3% |
| " 1324 | 60 ~ 62 | " | | | 2. 76 " | 3. 8 " | 5. 2 " |
| " 1329 | 70 ~ 72 | 1. 8 | | | 2. 62 " | 3. 3 " | 4. 9 " |
| " 1334 | 80 ~ 82 | 2. 0 | <0. 01 " | <0. 01 " | 2. 76 " | 2. 9 " | 5. 2 " |
| " 1339 | 990 ~ 92 | " | | | 3. 06 " | 3. 7 " | 5. 8 " |
| " 1344 | 100~102 | " | | | 2. 96 " | 3. 9 " | 5. 6 " |
| " 1349 | 110~112 | " | <0. 01 " | <0. 01 " | 3. 92 " | 3. 9 " | 7. 4 " |
| " 1354 | 120~122 | " | | | 4. 26 " | 4. 3 " | 8. 0 " |
| " 1359 | 130~132 | 1. 6 | | | 2. 48 " | 4. 1 " | 4. 7 " |
| " 1364 | 140~142 | 2. 0 | <0. 01 " | <0. 01 " | 2. 94 " | 3. 4 " | 5. 6 " |
| " 1369 | 150~152 | 1. 6 | | | 3. 16 " | 3. 6 " | 6. 0 " |
| " 1374 | 160~162 | 2. 0 | | | 2. 54 " | 5. 1 " | 4. 8 " |
| " 1379 | 170~172 | " | <0. 01 " | <0. 01 " | 3. 36 " | 5. 4 " | 6. 3 " |
| " 1384 | 180~182 | " | | | 1. 78 " | 3. 0 " | 3. 6 " |
| " 1389 | 190~192 | " | | | 2. 90 " | 2. 80 " | 5. 5 " |

sake of convenience.

"Relation Diagrams between Hole-depth and Assay results" (PL-II-7-2) shows the contents of pyrite and iron of each depth based on the assay results of core pieces. Geological observations and the extent of alteration are also described on the logs for reference.

After the pyrite contents divided into groups such as 1 to 3 %, 3 to 4 %, 4 to 5 %, the logs have been reillustrated according to the groups.

In addition, the relating simulation medels with their FE patterns and their original FE patterns based on the field survey are all overlapped and shown on the plate "Correlation of FE Anomalies with Pyrite contents in Drilled holes" (PLII-7-1).

From these diagrams and plates, the following articles can be understood;

(1) In the core drilling for the introduced three locations where FE anomalies were observed, higher contents of pyrite have been ascertained in each hole.

In Kyisindaung South, 2.1 % to 2.8 %, in Sabedaung South, 3.7 % to 4.4 %, in Kyaukmyet below 52 m to the bottom of the hole, 4.7 % to 6.3 % though almost barren from surface to 52 m, of pyrite content have been found.

(2) From the respective relations among the anomaly, drill-hole site, and the depth of the hole, the following facts can be inferred;

1) In Kyisindaung South, though, at the depth of 200 m from surface, strong FE anomaly was observed, the result of the core

assay has brought only a little more than 2 % of pyrite. Additionally, though FE 6 % was presumed between 67 m and 133 m in depth in the simulation models, the assay result of the drilled core has been proved to have pyrite content of 6.5 % to 7.7 % between 30 m and 60 m and 60 m, and 5.5 % to 6.7 % between around 90 m and 100 m in depth respectively. From this fact, it has been disclosed that the actual FE origin locates in shallower depth than that of the presumed model by simulation. In further observation of the diagram, it can be understood too that the alteration zone of sand stone and parphyry coincides well with the higher pyrite rich portions.

2) In Sabedaung South, the result of the field survey presented such FE values as of 3 % to 5 % from surface to minus 160 m and as over 5 % from 160 m to 200 m near the bottom of the hole.

In other hands from the selected simulation model, 4 % FE above 67 m depth to surface and 6 % FE below 67 m depth were inferred.

In the results of the drilling for these FE varieties, it has been disclosed that the core contains pyrite all through the hole to the bottom of 201.2 m from its collar as much as 4.1 % in average, with maximum content of 7.7 % and minimum 2.0 %, in better accordance with the above mentioned simulation model. Also it has been found that the pyrite content is high in argillized sandstone and/or geologically fractured zone, and generally low in lapilli tuff with strong chloritization.

3) In Kyaukmyet, an anomaly of FE over 3 % was detected in the deeper portion below 220 m with a weaker FE anomaly between 2% and 3% recognized above 150 m in depth.

But, in the actual assay results of the drilled core, the pyrite content has been found higher in general, in average 5.4 % below minus 50 m where the overlying river sediments of recent muddy sand has been passed through.

Especially, pyrite content becomes as high as 7.4 % to 8.0 % between 110 m and 120 m indepth.

Kyaukmyet hole is driven chiefly in mud stone, being found to bear pyrite the most of all the 3 holes. But it has so little amount of copper as below 0.01 %.

It may have been caught only as a weak anomaly by IP survey, because of its deep position as a whole.

In addition, a stronger pyritization has been recognized evenly below 85 m to the bottom of the hole 200.6 m in the core logging.

4-5. FE anomalies versus SP anomalies at Letpadaung

By the self potential method (hereafter SP) undertaken by Yugoslavian and Burmese geophysicists in 1957, 5 negative potential zones below -100 mV were discovered in the Letpadaung sector.

As shown in the map (PL II-8), these zones can be recognized within a large negative potential area distributed from the northern to eastern part of the Letpadaung hill, especially along its outernal margin on north, northeast, and east sides.

In correlating the SP anomalies with those of FE detected in the present survey, which being considered to express the extent of mineralization and alteration most of all in IP method, the followings can be observed;

(1) There is a good conincidence between SP and FE anomalies.

(2) SP anomalies were detected in and around the FE response body with FE over 8 % which has been inferred from the simulation.

(3) In the 25 drilled holes around the sites being chosen after the SP anomalies, almost all of them have been proved to contain copper bearing pyrite.

(4) Even on the marginal part of a SP anomaly, good copper mineralization has been recognized in places near a barren cap-rock.

From this finding, it may be inferred that SP anomalies have been detected selectively only in the shallower portions of a mineralized alteration zone, in other words the mineralized zone may distribute in a wider range than the SP anomaly concerned.

(5) In comparing the five SP anomalies each other, the following can be understood;

1) SP-V in the north is the largest and the strongest anomaly with -300 mV range.

In the anomaly, strong copper mineralization has been confirmed by the drill holes of No. 192, No. 188, etc. But it may be of a small scale mineralized zone locating in a relatively shallower level, because the strong FE response body concerned has been proved to have a narrow width.

2) On the contrary, SP-IV has shown itself the weakest SP anomaly of the 5 anomalies because of its weak potential differences between -100 mV and -200 mV.

3) The others, SP-I, II, III are rather strong SP anomalies with the potential differences between -200 mV and -300 mV.
Except SP-II, which is located on the mountain ridge, other 2 anomalies have been drilled for confirmation and ascertained to have comparatively strong copper mineralization.

## Chapter 5 Inference of subsurface structures by simulation

Even if the distributions of AR and FE have been visualized and presented in profiles after measuring them in IP survey and expressing them in respective plates using several adequate contourlines to help their interpretations, it is impossible to express directly the shape, size, and depth of the response body in AR and FE as of a subterranean structure.

The reason is because of the fact that it is not the response body itself, but only the image derived from the response body which has been measured and analyzed in this stage.

So, as a practical means to solve the matter, simulation of the block models in applied, in which a electronic computer is used for processing the concerning data.

In the actual performance of the simulation, the influences from the topography in the profile are demasked first to assume the surface horizontal, then the AR & FE patterns, drawn from the measured values both from the field data and the simulation model, are correlated to each other.

In the phase II survey, a strong IP anomaly zone was detected chiefly in and around the Letpadaung hill. So the following six spans have been chosen for simulation after studying the FE diagrams (PL-II-2-5 - II-2-8) which show the distributions of FE well in profiles.

(i) Line No. 17, between 25 SW and 13 SW 1.2 km

(ii) Line No. 18, between 22 SW and 10 SW 1.2 km

| | | |
|---|---|---|
| (iii) | Line No. 22, between 11 SW and 1 NE | 1.2 km |
| (iv) | Line No. 23, between 10 SW and 2 NE | 1.2 km |
| (v) | Line No. 26, between 9 SW and 3 NE | 1.2 km |
| (vi) | Line No. 27, between 10 SW and 2 NE | 1.2 km |
| | Total 6 spans | 7.2 km |

For each of these spans, simulation has been applied for several times, after excluding the unnecessary influences of the topography. The patterns are those obtained from the simulation, which come close to the patterns directly based on the field surveyed data both on AR and FE as shown in the attached plates. (PL II-3-1 ~ II-3-6)

Of these patterns, especially FE patterns are collected in PL II-4-1 for the convenience of mutual comparison among the spans.

Further, the plate II-4-2, "Letpadaung IP Response Body inferred from Simulation" has been summarized to distinguish the strong FE response body discovered in the northern side of the Letpadaung hill of its whole scale, shape, and depth by inferring the response body which has originated the respective anomaly observed as simple FE anomaly on other lines besides the investigated lines by simulation. Those five inferred models without simulation study are shown, on the above mentioned plate, in dotted outlines, while the models after simulation in real lines.

In addition, on the plate, the bottom of the strong FE response body over 8 % in FE has been assumed down to minus 400 m at most from the local flat plain, after considering both the depth of the drilled holes being around 300 meter and some of them being recognized to show mineralization near to their hole-bottoms.

In summarizing to deduce the conclusive idea of the anomalous underground structure, the horizontal extension of the strong FE response body on minus 200 m from the assumed surface has been illustrated in "Geophysical Explanation Map of Letpadaung Sector" (PL II-1-2), etc.

For additional reference, the summarized results of the copper assay of the drilled holes have been illustrated on the eleven profiles of "Letpadaung IP Response Body inferred from Simulation" (PL II-4-2) from the line No. 17 to the line No. 27.

## Chapter 6 Inferable geological structure from IP survey

### 6-1. General geological structure inferred

In the IP survey of phase II, the survey lines were set chiefly on the following purposes;

(1) To cover and complete the adjacent flat area in the south eastern part of the phase I survey

(2) To investigate and infer the location of probable zone optimum for copper ore deposition by surveying the topographically prominent portions and their vicinities such as Shwebontha, Taungzone, Letpadaung, and other small hills in the west of Letpadaung etc by means of IP method.

In results, the geological structure of the plain in the IP surveyed areas, mostly consisting of pyroclastics, sandstone, and mudstone of Magigon formation and partly covered with mudstone and sandstones of Kangon formation, has been found almost a FE barren zone with medium to high resistivity of upto 50Ω-m at most. Though the extension of the Kyaukmyet IP anomaly detected in the phase I survey has been caught in the south of Kyankmyet hill, there have not been found new anomalies except the supposed extension of the Letpadaung altered zone with low resistivity and strong FE anomaly mainly in the east and south of Letpadaung hill.

On the contrary, the prominent portions such as Shwebontha, Taungzone, Letpadaung etc., composed of rhyolite and/or biotite hornblende porphyry and so on, have been detected by IP survey as a high resistivity zone with very high partial resistivity over 50 Ω-m.

Especially in some part of Letpadaung, a contractive up and down distribution of resistivity has been found with both a very high resistivity zone over several hundred Ω-m caused by strong silicification and alunitization above and a corresponding low resistivity zone under 7Ω-m caused by strong argillization and pyritization below.

These are all derived from the secondary alterations.

Shwebontha, Taungzone, and small hill in the west of Letpadaung have also been detected as higher resistivity zones, but they have had little FE. So they are supposed to be composed of rather fresh igneous rocks.

In the mean time, some high magnetic and electro-magnetic anomalies are reported in the vicinity of Taungzone hill in the report (Applied Geophysics Unit Report No. 13 : 1972) on the ground magnetic survey and electro-magnetic survey done by MMDC geophysicists, but these can be inferred to have been derived from the influences of some dykes with magnetic minerals and boxworks of hematite in the porphyry etc. which have been recognized in the surface reconnaissance.

6-2. Correlations on Letpadaung alteration zone

The geological alteration zone in the Letpadaung Sector can be summarized as shown in PL.II-9-1 & II-9-2, after the present geological survey, and correlated to the strong FE response body of over 8% in FE inferred through the simulation.

The relations between the alteration zone and the response body can be described as in the following :-

(1) On the relation with silicification and argillization

The prominent portion of the Letpadaung hill is governed by the rhyolitic dykes and the silicification zone elongating from southwest to northeast as shown in the Plate II-9-1.

The summits of the hill are strongly silicified almost all over the hill in Letpadaung.

On the other hands, weak argillization can be recognized throughout the Letpadaung hill in accordance with the weak silicification zone which contains the strongly silicified zone mentioned above. But the strongly argillized portion can be observed only in the limited location. Strong argillization can not be observed in large scale in other places except along the bottom of the central valley of the hill.

It is obviously understood that the strong FE response body situates at the location which has not special relations with the described weak silicification and argillization zones.

Also there is almost no relation to be recognized between the strong FE response body and the strongly argillized zone on surface.

The strongly silicified zone can not be recognized to have such a relation too, but it may be said that the strong FE response body locates along a part of the margin of the strongly silicified zone especially in the north to eastern part of it.

(2) On the relation with alunitization

The alunitization can be observed in such limited regions as in the north, east, and southeast of Letpadaung hill as shown in Plate II-9-2, not in the center and southwest of the hill.

Especially, the strongly and very strongly alunitized zones are located in limited places.

They are distributed only in the northern and eastern mountaineous locations.

And most of them are seen within the range of the strong FE response body of over 8 % in FE.

From these observations, the alunitization can be inferred to have a very close relation with the strong FE response body.

6-3. Correlations with copper assay results of the old core samples from Letpadaung

In Let padaung, 25 holes (over 6,000 m in total) of core drilling have been drilled and their samples have assayed on copper by the Burmese authority, since 1957 when SP prospecting was applied for the hill by Yugoslavian and Burmese experts.

Unfortunately their core recovey is so low as approximately from 30 % to 40 %, so the assay data may have some deviation a little.

But taking the respective assay data as granted to simply represent the content of copper of the relating length of the drill hole, the relations between the depth of the hole and the respective copper content can be illustrated, on each hole in the scale of 1 to 5,000, as in the attached map "Inferred Copper Content in Letpadaung Drill Holes" (PLII-10), though the assay data of No. 139 hole is missing.

In correlating the assay log results by Burmese to the concerning drilled sites and the strong FE response body over 8 % in FE, the following articles can be understood.

The explanation needs to divide the holes on their location into five groups :-

SP-III group : 5 holes, No. 1, 2, 4A, 9 and 12

SP-II group : 6 holes, No. 19, 33, 34, 35, 38 and 60

SP-I group : 5 holes, No. 80, 85, 91V, 92 and 104

SP-IV group : 2 holes, No. 139, and 158

SP-V group : 7 holes, No. 168, 174A, 176A, 176, 181, 188 and 192

Total 25 holes

The drilled site of each hole is shown in detail in Figure II-6, II-7 and II-8

(1) SP-III group (Around the old pits on the east-margin)

Though all the holes are drilled out of the strong FE response body, they have been recognized to contain copper in the core pieces.

Especially, outstanding high grades of copper have been proved in No. 9 & No. 1 holes both locating on the side slope of the hill.

In No. 12 hole near the top of the topgraphy, the thickness of the leached zone is 130 m, and under the zone a copper bearing zone of 0.71 % to 0.23 % of copper has appeared down to the bottom of the hole, 170m.

On the contrary, the copper content of the holes No. 2 & No. 4A

Fig. II - 6  Drilled-Sites in Detail  Letpadaung (East)

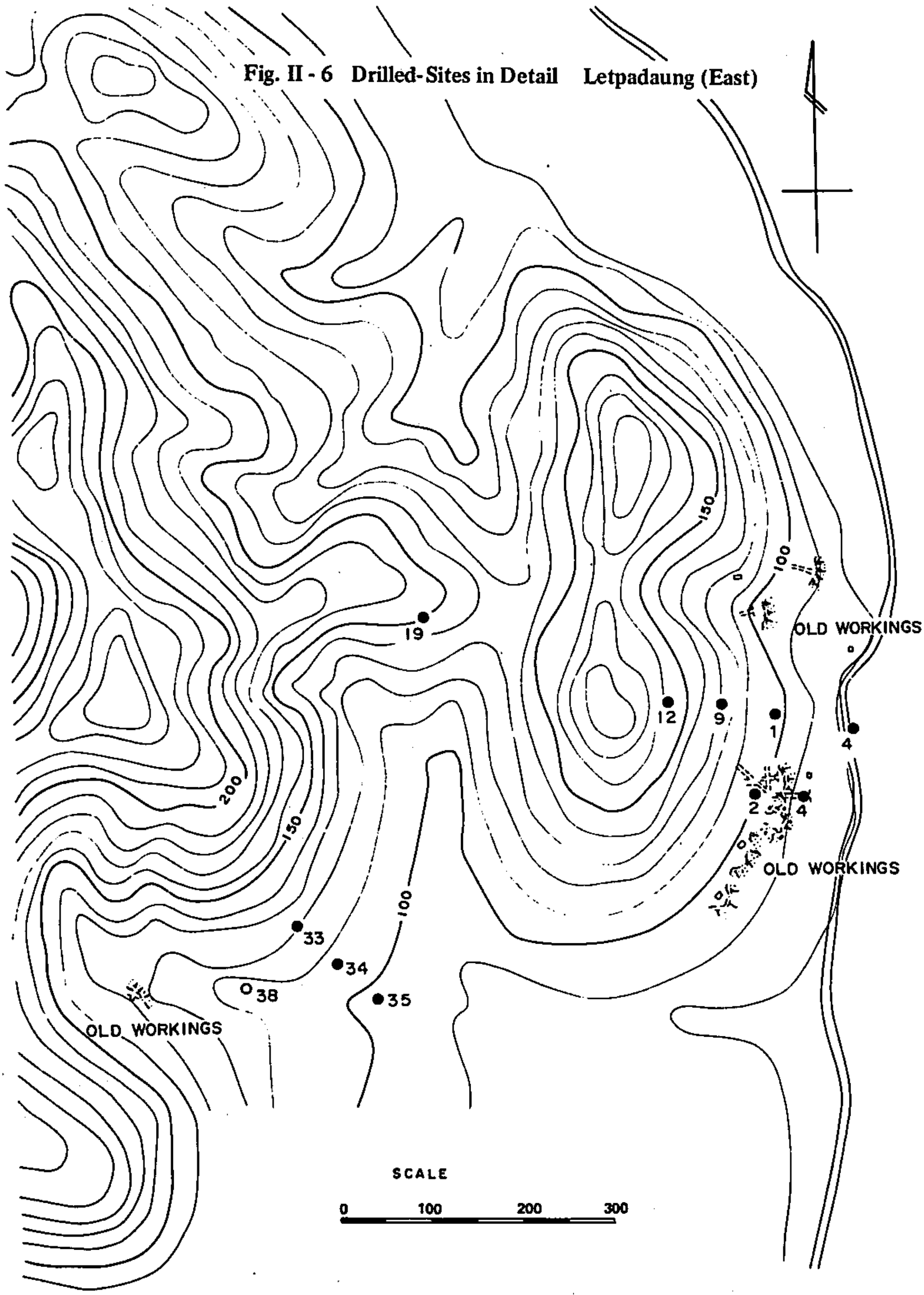


Fig. II - 7 Drilled-Sites in Detail Letpadauung (Center)

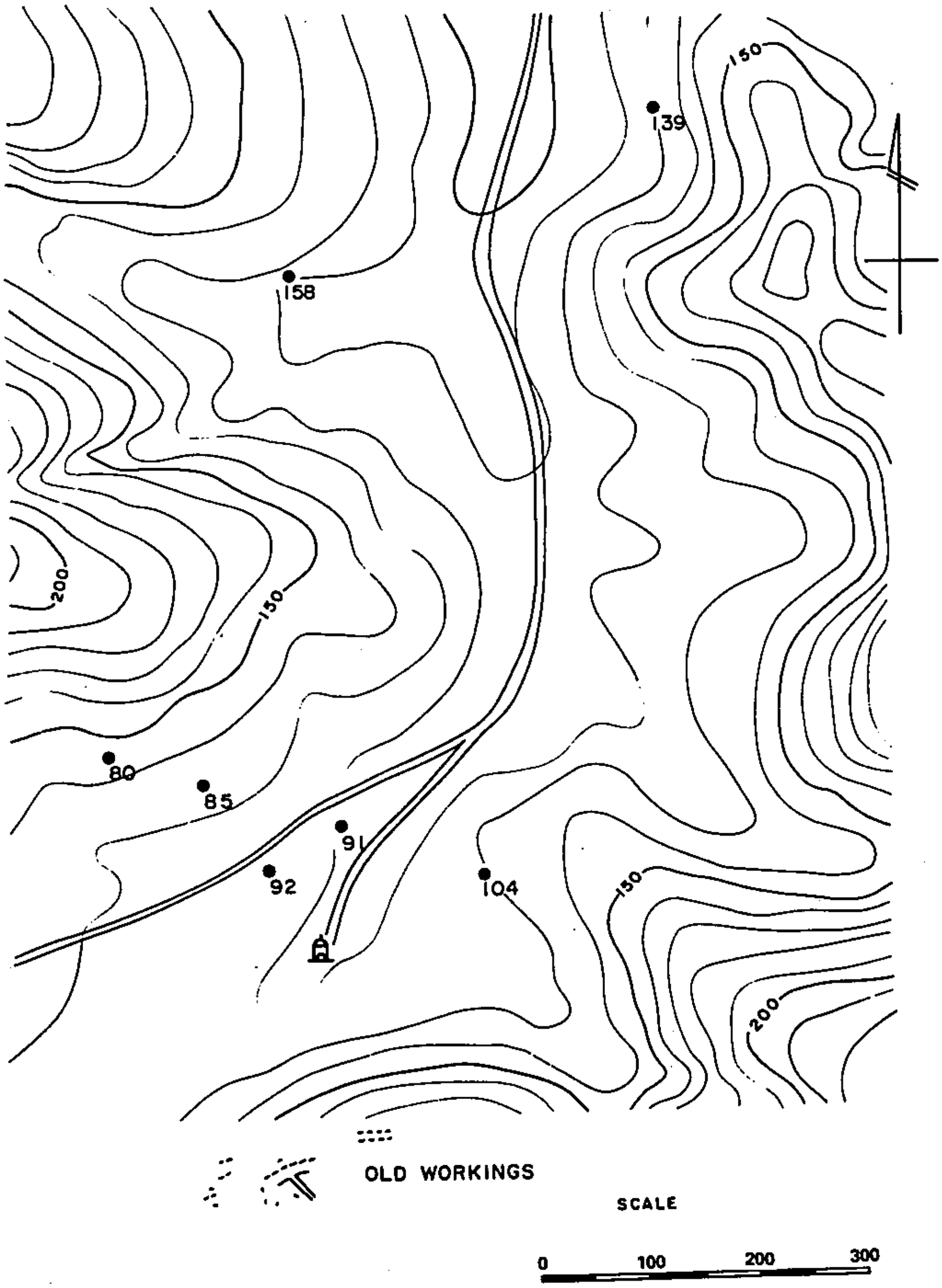
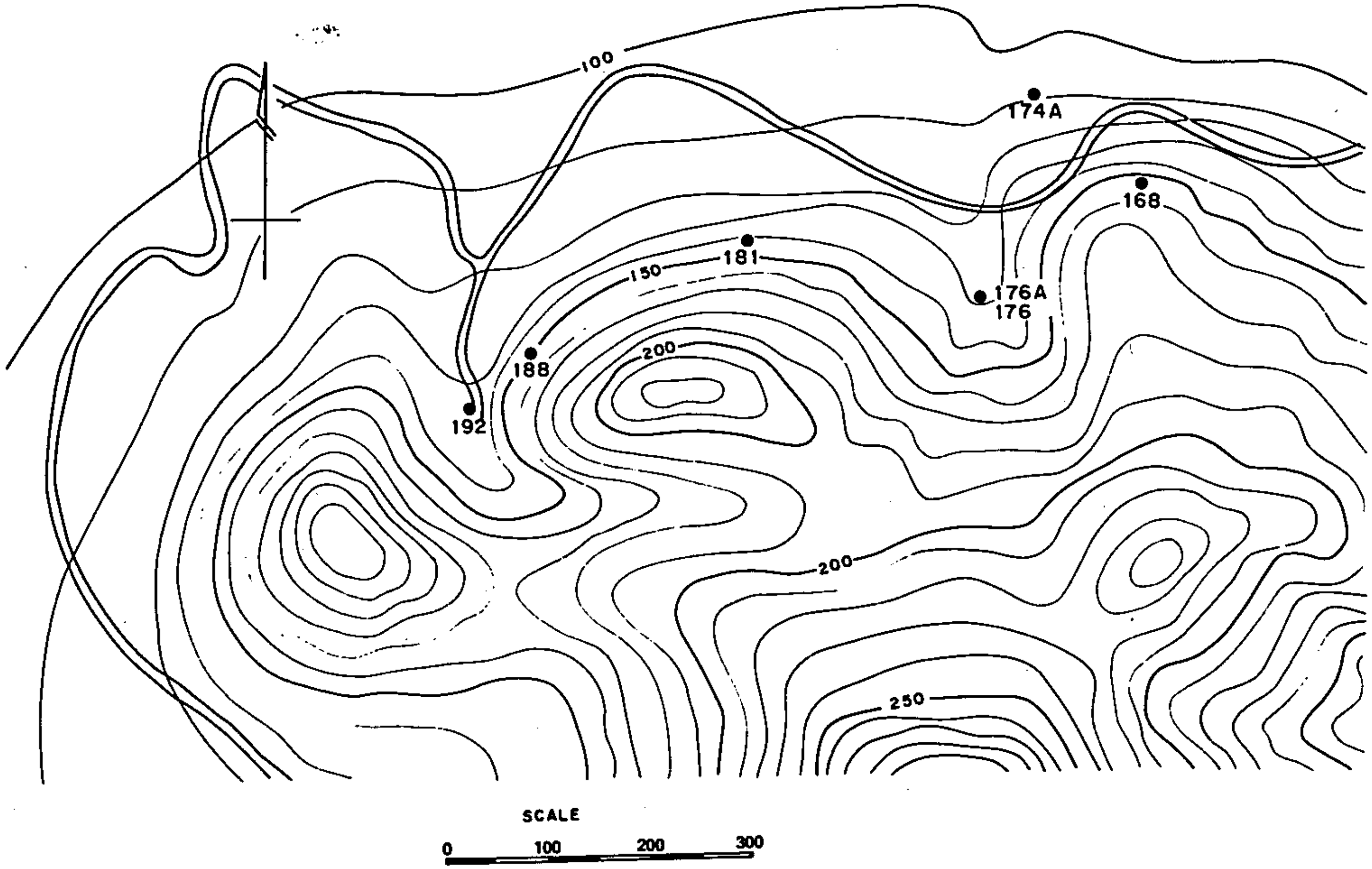


Fig. II - 8 Drilled-Sites in Detail Letpadaung (North)



both drilled at the foot of the hill has decreased considerably. Through these observations, it can be inferred that there might be a higher grade copper are reserve underneath a thick portion of a leached zone.

(2) SP-II group (Southeast of Letpadaung)

Except No. 19 hole, all the holes are drilled on the outside of the strong FE response body, of these, No. 38 & No. 60 holes have shown copper zones of over 0.5 %. Both of them are close to the strong alunitization.

No. 19 hole, locating inside of the response body, has shown an average copper grade of 0.38 % for the thickness of 118 m between the hole depth of 47 m and 165 m. Though the grade is lower, its thickness can be estimated.

On other 3 holes, No. 33, 34, and 35, their copper content is very low in common. The reason may be caused by their locations on the lower footside of the hill.

No. 33 hole, situating at the highest elevation of the three holes, has shown 0.41 % copper between the depth of 22 m and 66 m.

No. 34 hole, a little lower in its collar elevation, has been proved to have 0.38 % in copper grade between 35 m and 39 m in depth.

No. 35 hole, nearly on the lowest flat plain, is almost barren in copper, though it shows 0.3 % copper in a small portion.

(3) SP-I group (Near the central monastery)

The holes of the group are drilled in the central valley of Letpadaung with their collars at lower elevation, and yet their copper content is high in general, though they are also drilled apart from the strong FE response body over 8 % in FE.

In case of No. 104 hole, the copper content is so high as 1.38 % between 24 m and 61 m, and low as from 0.2 % to 0.3 % between 61 m and 162 m in depth respectively.

In No. 92 hole, the copper grade is also high as 1.28 % between 173 m and 200 m, 0.46 % between 200 m and 211 m, and 0.56 % between 215 m and 245 m each in depth. And even between 80 m and 160 m, a copper mineralized zone can be recognized with 0.32 % to 0.53 % of copper.

Other holes, No. 80, 85 and 91 V also show some copper mineralizations, but their intensity and scale are rather negligible at present.

(4) SP-IV group (Near MMDC drilling center)

The group situates on the strong FE response body over 8 % in FE, and in the hole No. 158 the higher copper content of 3.35 % has been disclosed between 49 m and 67.5 m in depth, 1.39 % between 67.5 m and 101 m, and 0.42 % between 107 m and 128 m, from all these figures the copper grade can be recognized very high in around the hole.

Though driven nearly at the center of the strong FE response body over 8 % in FE, No. 139 hole has left no assay data, and its core-samples have not been kept at all, so it is necessary for the region to receive new drilling holes in earlier days.

(5) SP-V group (Northwestern Letpadaung)

The holes of the group have been drilled on around the strong SP anomaly found in the northern part of Letpadaung hill.

Each of the holes has detected the copper mineralized zone. Especially, 2 holes of No. 188 & No. 192 in the western part have caught the copper grades of 1.02 % between 38 m and 89 m, and 0.64 % between 19 m and 54 m respectively. The locations of the holes of the group are observed in the ranged the strong FE response body over 8 % in FE inferred from the present IP survey and the simulation, but they are selected on around the foot of the hill.

So it is recommended to drill holes at the higher elevations where the leached zone is thick and the high grade copper ore deposits can be expected in the results.

## Chapter 7 Conclusion

(1) In the north to northeastern part of Letpadaung hill on its mountaineous to outskirt portion, an extensive IP anomaly zone of above 3 % in FE value has been detected in the geophysical survey, which is estimated to have an area of around 4 $km^2$ with its maximum width of about 2 km, average width around 1 km, and east-west elongation of about 4 km.

In the central portion of the anomaly, there has been also found stronger FE concentration of above 8 % in FE value. And the strong FE range is convinced to have approximately 1.7 $km^2$ in horizontal extention with its narrow width of 0.2 km in the west, 0.8 km swelling in the east both on the Letpadaung hill. Its length is estimated as 3.5 km in east to west direction.

(2) Out of the Letpadaung anomaly, the possible extension of Kyaukmyet FE anomaly zone toward the south has been caught which anomaly was detected originally near Kyaukmyet hill in the Phase I survey.

The anticipated FE anomalies have not been observed both around Taungzone and Shwebontha hills.

(3) In close observation of the Letpadaung FE anomaly, the following fact can be understood :

The FE anomaly intensity is strong on the higher portion and footside of the hill in north to northeastern range, and there is a FE barren zone in its southwest range. Over this barren zone farther in the southwest, there is another FE anomaly zone of medium intensity.

So as a whole, somewhat flattened donuts like shape of FE anomaly can be recognized with its elongation from east to west direction.

The FE barren zone coincides to the mountain ridge in general, suggesting that it may have occurred in relatively strong leaching on the prominent portion of the ground, causing the quicker dissolution of the original sulphide minerals than on other portions.

(4) Through the findings of the present IP survey, the relations among the relative resistivity, FE intensity, and copper enrichment might be inferred as in the following,

1) The main cupriferous zone in Letpadaung is a reduced sulphide zone with secondary enrichment. This enriched zone can be correlated geophysically to a very low zone in relative resistivity with strong FE effect, which generally situates either underneath or along the margin of a very high or high resistive zone.

The higher resistive zone, locating just below the surface, generally never shows FE effect, so it may be correlated to a leached silicified zone geologically.

In the vertical electric sounding with the Schlumberger's configuration tested on the flat for the northwestern extension of

Letpadaung FE anomaly, a high resistivity zone was found near the surface with a low resistivity zone below.

In its simulation study under dipole-dipole configuration too, the high resistivity zone is found as FE barren zone, and the low resistivity zone as strong FE zone. This fact also endorses the above introduced inference.

2) The introduced inference can be also considered reasonable in recognizing the fact that the relatively stronger copper mineralization has been detected in the drill holes done by the Union of Burma around the locations with strong alunitization observed on the surface in FE anomaly zone found in the north to northeast of Letpadaung hills.

From these facts, in exploring copper ore, atmost attention should be paid for the strong FE anomalies found under the very high to high resistivity zone or in its vicinity which can be correlated to the silicification and/or alunitization zone.

3) Attention also should be given to the comparatively weaker FE anomaly at some portion of the mountain foot.

The reason is explained as the following:

In the core drilling at the southwestern foot of the donuts shaped FE anomaly, preveously introduced as in (3), comparatively strong copper mineralization has been reported, though the detected FE intensity is not so strong. And this may indicate the possible existence of an enriched ore zone caused both by the leaching and secondary concentration of copper through its ionic behaviour.

(5) Three holes of each 200 m, in total 600 m, were drilled in the phase II survey at the three locations in Kyisindaung South, Sabedaung South, and Kyaukmyet, which had been selected after the IP anomalies disclosed in phase I. In results after the assay, the holes are found to have pyrite as much as between 2.6 % to 4.2 % in average of each hole length.

Especially at Sabedaung South, where IP anomaly coincides with the alteration zone on surface, a chalcocite mineralization has been proved, though not considerable in content.

From the fact that around the known ore deposits of Kyisindaung and Sabedaung the IP anomalies were found to overlap the geological alteration zone, Sabedaung South can be suggested as one of the strongly mineralized localities, and considered as an important zone for further exploration. On the other hands, Kyaukmyet and Kyisindaung South anomalies are inferred to have been derived from pyrite with little copper minerals in the analysis in reference to the above mentioned drilling results, so they may have less chances for further exploration.

(6) Recomendation

As shown in the attached map (PLII-1-2), 7 holes of confirmation drilling of 2,000 m in total are proposed for the detected strong FE anomaly zone on Letpadaung hill in the following succession. Of these, five holes are selected onto the higher hill sides with thick high resistivity zone on top of them, the other two holes for the places where there can be expected the presence of enriched bodies caused by secondary concentration through the shifting of ionic copper.

| Name of holes | Recomended drill-site | Hole length |
|---|---|---|
| No. 1 | Around 2 SW station, line No. 26 | 300 m |
| No. 2 | " 12 SW " , line No. 19 | 300 m |
| No. 3 | " 3 SW " , line No. 23 | 300 m |
| No. 4 | " the midpoint of 8 SW stations on lines, No. 20 & No. 21 | 300 m |
| No. 5 | " the midpoint of 3 SW stations on lines, No. 24 & No. 25 | 300 m |
| No. 6 | " 13 SW station, line No. 23 | 250 m |
| No. 7 | " the midpoint of 3 SW stations on lines, No. 21 & No. 22 | 250 m |
| | Total hole length | 2,000 m |

The above mentioned succession of the drill-site has been decided after considering the following criteria, namely ;

1) The hole should be selected in the location where there are both a very high and/or high resistivity zone in the upper portion and a contrastive lower resistivity zone with very strong FE beneath it.

2) On surface, where there can be observed a strong alunitization.

3) Where it is closer to the known copper mineralization

4) Where there can be anticipated a large ore deposit because of the wide extension of the stronger FE anomaly.

The recommended drill holes have been classified as in the following, according to the criteria;

| Name of Group | Name of Hole | Adopted criterial item |
|---|---|---|
| I | No. 1 | 1, 2, 3, 4 |
| II | No. 2 | 1, 2, 3 |
| | No. 3 | 1, 2, 4 |
| III | No. 4 | 1, 2 |
| | No. 5 | 4 |
| IV | No. 6 | 3 |
| V | No. 7 | 4 |

# PART III DRILLING

## PART III. Drilling

## LIST OF ILLUSTRATIONS

Appendices (Drilling)

# PART III DRILLING

## CHAPTER 1 SUMMARY OF DRILLING WORKS

The drilling project for the second year phase was performed the purpose of making clear the geological structure and the features of mineralized zones in Sabedaung and Kyisindaung Areas as well as for the investigation of the geophysical anomalies (I. P. Survey) found in the Areas, commencing the operations of November 26, 1973 and completing the entire works on March 30, 1974 with 18 holes drilled during the period covering the length of 3,319.40 meters in total.

The drilling was conducted mostly in two shifts by two teams organized as in the last year phase with the participation of one Japanese supervisor and 6 technicians, employing 2 rigs of drills (TEL-3B and TGM-2C) having wireline method applied.

The 18 holes drilled (refer to Fig. for the drilling locations) consist of 8 holes (DDHs. JS-2, JS-3, JS-4, JS-5, JS-6, JS-7, JS-9 and JS-10) intended to make a detailed survey of Sabedaung Deposit, 4 holes (DDHs. JS-1, JS-8, JS-11 and JS-12) to survey the expansion of Sabedaung Deposit, 3 holes (DDHs. JK-1, JK-2 and JK-3) to survey the southern extension of Kyisindaung Deposit and 3 holes (DDH IP-1, DDH IP-2 and DDH IP-3) to survey the IP anomalies in Kyisindaung south area and Kyankmyet area.

An attempt made to improve the drilling method through the experience and results in the preceding year along with the reinforced equipment and supplies has brought a substantial success in the operation. In addition, special consideration have been given to strengthen the operational training of local workers on job and to have 2 technicians from the last year's members joined in the present survey party for the efficient performance of the operations. In consequence, the efforts of the party members and cooperation of the Burmese personnels concerned have been successfully combined to obtain the expected results within the period originally set forth.

## CHAPTER 2 DRILLING METHOD AND RIGS EMPLOYED

At the inception of the drilling operation in the previous year phase, 1972, the drilling method had been designed suitably to work the rocks, which were anticipated to be andesitic rock and tuff, and this was proved successful, on the whole, as comforming to the geological conditions of the project except for several minor problems. In establishing the drilling method for this year phase, 1973, several points have been taken into account as viewed necessary from the results of the operations of last year, which are outlined as follows.

### 2-1 Ore Deposits and Geology from Drilling Standpoint.

(1) In the two drilling areas of Sabedaung and Kyisindaung, unlike the case of vein-type deposits where a clear distinction in rock nature can be observed between are portions and those of country-rock, all the rocks to be drilled should be considered as a similar rock unit in terms of drilling method, and it is necessary to work out appropriate drilling measures adaptable thereto.

(2) The object area of drilling is an altered zone consisting generally of hard portions such as quartz veinlets and soft clay portions mixed with each other.

(3) The ore deposits consist of substantially brecciated rocks, accompanied by faults and sheared zones in various parts.

(4) In order to perform the effective drilling operations under the conditions given as above, it is;

(a) important to take appropriate measures to secure a high rate of core recovery;

(b) most desirable to plan to recover cores as completely in a columnar form as possible, because ores in the fissure or a accompanied by quartz veinlets are liable to clog within the core-barrels, crushed and mixed in sludge causing the high grade portion washed away, thus lowering the grade of cores on the whole, although the disseminated portions generally show a high rate of recovery. It should be also noted that fragile sulphides are easily fractured into small pieces while compact and barren portions tend to remain as cores; and

(c) necessary to prevent part of ore minerals from dissipating along with sludge out of the holes, in consequence of the decline of core recovery as the holes tend to cave down and loss of water happens frequently when drilling the sheared or clay zones or other areas where fissures and faults are developed.

## 2-2 Measures Taken for Drilling Method

In accordance with the observations above-mentioned, measures have been taken as follows.

### 2-2-1 Drilling Equipment

(1) On the assumption that the distribution ratios of rocks to be drilled

are 75% of medium hard rocks, 20% of hard rocks and 5% of soft portions (clay, etc.), the rotation speed of the drilling machine has been set at a moderate of 300 r.p.m. mostly aiming at the medium hard to prevent the caving of holes that might be cuased by the vibration of strings and to secure the stabilized recovery of cores within the core-barrels.

(2) NX wireline has been selected as the main size of cores, with BX wireline as the minimum with the intention of securing, in particular, the high rate of recovery and the stabilization of holes.

(3) The specifications of diamond bits have been designed as follows to enable the wireline to function efficiently toward medium hard rocks, the main objectives to be drilled, i.e. matrix of R.C. 30, diamond size 1/25, 5-6 steps, and 4-6 waterways.

2-2-2 Circulation Media for Drilling

(1) It has been planned to use mud-fluid to obtain a high rate of recovery of cores and to secure the stabilization of holes while they are kept drilling, and particularly to the drilling of rhyolite, tuff-breccia and clay zones, chromenite has been applied to protect the wall of holes and facilitate the draining out of sludge.

(2) Cementation has been carried out to prevent the loss of water in holes and for the effective use of mud-fluid.

(3) 2% of cutting oil has been added in proportion to the total quantity of the circulation materials to improve the cutting efficiency as well as for reducing friction to prevent wear and tear and vibration of strings.

The types and specifications of the drills used are as shown in Table 3-1.

Table 3-1(A) Drilling Equipment and Consumed Materials

A TEL - 3B (1)

| Item | Type | Specifications | Quantity |
|---|---|---|---|
| Drilling machine | TEL - 3B (TONE Boring Co., Ltd.) | Capacity (m) 800 m<br>Dimensions Hight 1,380 mm<br>Length 2,820 mm<br>Width 1,200 mm<br>Weight (Except Power Unit) 2,200 kg | 1 set |
| | Swivel Head | Spindle speed<br>270, 540, 720, 1,200 r.p.m.<br>150, 300, 400, 670 r.p.m. | |
| | Hoist | Planetary Gear<br>Hoisting Capacity 4,500 kg | |
| | Oil Pump | Automatic Variable Delivery Vane Type<br>Capacity 0~100ℓ/min.<br>Max. Pressure 70 kg/cm$^2$ | |
| Motor | F4L. 912 (Mitsui Deuts, Co.) | Diesel Engine<br>Revolution 1,200~2,400 r.p.m.<br>Related Power 22~43 p.s. | 1 set |
| Drilling Pump | NAS - 3 | Duplex Cylinder Double Action<br>Weight (Except Power Unit) 330 kg<br>Piston Diameter 75 m/m<br>Stroke 50 m/m<br>Discharge Capacity 130ℓ/min.<br>Max. Pressure 70 kg/cm$^2$ | 1 set |
| Motor | NS - 110 (Yammer Diesel Co.) | Diesel Engine<br>Revolution 2,200 r.p.m.<br>Related Power 11 p.s. | 1 set |
| Mud Mixer | MCE - 100A | Tankage 125ℓ<br>Mixing Capacity 100ℓ<br>Mixing Revolution 800 r.p.m. | 1 set |

A TEL - 3B (2)

| Item | Type | Specification | Quantity |
|---|---|---|---|
| Motor | NS - 40<br>(Yammer Diesel Co.) | Diesel Engine<br>Revolution 2,000 r.p.m.<br>Related Power 4 p.s. | 1 set |
| Water Supply Pump | NAS - 3 | Same as Drilling Pump | 1 set |
| Motor | NS - 110 | Same as Drilling Pump's Motor | 1 set |
| Derick | DR - 12 | Height 12.5 m<br>Max. Road Capacity 20 ton | 1 set |
| Generator | YSG - 1.5 S | Capacity 1.5 KW, 15 KVA<br>Voltage 100 V<br>Electric Current 15 A | 1 set |
| Motor | NS - 40<br>(Yammer Diesel Co.) | Revolution 2,000 r.p.m.<br>Related Power 4 p.s. | 1 set |
| Drill Rod | | NQ - 3 m<br>BQ - 3 m | 81 pcs.<br>121 pcs. |
| Casing Pipe | | 112 m/m - 3 m<br>NX - 3 m<br>BX - 3 m | 4 pcs.<br>20 pcs.<br>80 pcs. |
| Rod Safty Clamps | | RH 85 | 1 set |
| Water Swivel | | DH Type | 1 set |
| Traveling Block | | | 3 pcs. |
| Hoisting Swivel | | B Type | 1 set |

Table 3-1(B) Drilling Equipment and Consumed Materials

B TGM - 2C (1)

| Item | Type | Specifications | Quantity |
|---|---|---|---|
| Drilling machine | TGM - 2C (TONE Boring Co., Ltd.) | Capacity (m) 550 m<br>Dimensions Height 1,520 mm<br>Length 2,430 mm<br>Weight (Except Power Unit) 1,200 kg | 1 set |
| | Swivel Head | Spindle Speed<br>200, 500, 770, 1,000 r.p.m. | |
| | Hoist | Planetary Gear<br>Hoisting Capacity 2,200 kg | |
| | Oil Pump | Automatic Variable Delivery Vane Type<br>Capacity 0~100ℓ/min.<br>Max. Pressure 70 kg/cm$^2$ | |
| Motor | F3L. 912 (Mitsui Deuts, Co.) | Diesel Engine<br>Revolution 1,800~2,000 r.p.m.<br>Related Power 33~36 p.s. | 1 set |
| Drilling Pump | NAS - 3 | Duplex Cylinder Double Action<br>Weight (Except Power Unit) 330 kg<br>Piston Diameter 75 m/m<br>Stroke 50 m/m<br>Discharge Capacity 130ℓ/min.<br>Max. Pressure 70 kg/cm$^2$ | 1 set |
| Motor | NS - 110C (Yammer Diesel Co.) | Diesel Engine<br>Revolution 2,200 r.p.m.<br>Related Power 11 p.s. | 1 set |
| Mud Mixer | MCE - 100A | Tankage 125 ℓ<br>Mixing Capacity 100 ℓ<br>Mixing Revolution 800 r.p.m. | 1 set |

B TGM - 2C (2)

| Item | Type | Specification | Quantity |
|---|---|---|---|
| Motor | NS - 40<br>(Yammer Diesel Co.) | Diesel Engine<br>Revolution 2,000 r.p.m.<br>Related Power 4 p.s. | 1 set |
| Water Supply Pump | NAS - 4 | Duplex Cylinder Double Action<br>Weight (Except Power Unit) 640 kg<br>Piston Diameter 85 m/m<br>Stroke 90 m/m<br>Discharge Capacity 250ℓ/min.<br>Max. Pressure 70 $kg/cm^2$ | 1 set |
| Motor | F3L. 912<br>(Mitsui Deuts, Co.) | Same as Drilling Machine | 1 set |
| Derick | DRPQ - 5 | Height 12.5 m<br>Max. Road Capacity 20 ton | 1 set |
| Drill Rod | | NQ - 3 m<br>BQ - 3 m | 81 pcs.<br>121 pcs. |
| Casing Pipe | | 112 m/m - 3 m<br>NX - 3 m<br>BX - 3 m | 4 pcs.<br>20 pcs.<br>80 pcs. |
| Rod Safty Clamps | | RH 85 | 1 set |
| Water Swivel | | DH Type | 1 set |
| Hoisting Swivel | | B Type | 1 set |

Table 3-1-C(1)

| Description | Specification | Unit | Quantity | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DDH JS-1 | DDH JS-2 | DDH JS-3 | DDH JS-4 | DDH JS-5 | DDH JS-6 | DDH JS-7 | DDH JS-8 | DDH JS-9 | DDH JS-10 | DDH JS-11 | DDH JS-12 | DDH JK-1 | DDH JK-2 | DDH JK-3 | DDH IP-1 | DDH IP-2 | DDH IP-3 | Com. | Total |
| Gasoline | | ℓ | | | | | | | | | | | | | | | | | | | 400 | 400 |
| Light oil | | 〃 | 265 | 350 | 340 | 305 | 315 | 390 | 410 | 530 | 500 | 400 | 440 | 320 | 710 | 545 | 710 | 365 | 340 | 450 | 2,600 | 10,285 |
| Mobil oil | engine | 〃 | 6 | 20 | 10 | 15 | 20 | 7 | 16 | 10 | 12 | 12 | 12 | 12 | 30 | 25 | 30 | 12 | 18 | 15 | 200 | 482 |
| Mission oil | gear | 〃 | 5 | 14 | 5 | 5 | 8 | 4 | 7 | 10 | 5 | 5 | 5 | 7 | 13 | 10 | 13 | 7 | 10 | 12 | – | 145 |
| Turbine oil | oil pressure | 〃 | 100 | 100 | | | | 40 | 40 | | | | | | 40 | | | 40 | | | | 360 |
| Grease | | kg | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 5 | 3 | 2 | 2 | 3 | 4 | 2 | | 2 | 3 | 3 | 60 | 107 |
| Bentonite | 25kg/Bag | 〃 | 270 | 415 | 330 | 280 | 280 | 260 | 220 | 260 | 180 | 140 | 220 | 100 | 250 | 210 | 250 | 100 | 130 | 530 | – | 4,425 |
| Chromenite | | 〃 | 122 | 142 | 118 | 202 | 84 | 94 | 83 | 121 | 81 | 67 | 90 | 40 | 110 | 70 | 110 | 37 | 40 | 251 | – | 1,862 |
| Caustic soda | | 〃 | 2 | 3 | 2 | 4 | 3 | 5 | 8 | 8 | 12 | 10 | 12 | 6 | 19 | 14 | 19 | 8 | 11 | 12 | | 158 |
| C. M. C. | | 〃 | 12 | 32 | 32 | 25 | 25 | 28 | 26 | 50 | 18 | 20 | 23 | 15 | 33 | 27 | 33 | 17 | 15 | 77 | | 508 |
| Sero seal | | 〃 | | 15 | | 7 | | | 10 | | 30 | | | | | 20 | | | | | | 82 |
| Teruseal | | 〃 | | | | | | | 15 | | | | | | | 10 | | | | | | 35 |
| Metal crown | 101 % | pec. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 18 |
| Single core tube | 101 %× 1.5 m | set | | | | | | | | | | | | | | | | | | | 2 | 2 |
| Double core tube | 101 %× 1.5 m | 〃 | | | | | | | | | | | | | | | | | | | 2 | 2 |
| Double core tube | NQ.WL | 〃 | | | | | | | | | | | | | | | | | | | 10 | 10 |
| Double core tube | BQ.WL | 〃 | | | | | | | | | | | | | | | | | | | 8 | 8 |
| Core tube head | 101 % | Pec. | | | | | | | | | | | | | | | | | | | 4 | 4 |
| Core tube head | NQ.WL | 〃 | | | | | | | | | | | | | | | | | | | 10 | 10 |
| Core tube head | BQ.WL | 〃 | | | | | | | | | | | | | | | | | | | 6 | 6 |
| Casing head | 112 % | 〃 | 1 | | | | | 1 | | | 1 | | | | 1 | | | 1 | | 1 | | 6 |
| Casing head | NX | 〃 | | 1 | | | | 1 | | | 1 | | | | 1 | | | 1 | | 1 | | 6 |
| Casing head | BX | 〃 | | 1 | | | | 1 | | | 1 | | | | | 1 | | | 1 | 1 | | 6 |
| Casing metal shoe | 112 % | 〃 | | | | | | | | | | | | | | | | | | | 3 | 3 |
| Casing metal shoe | NX | 〃 | | | | | | | | | | | | | | | | | | | 10 | 10 |
| Casing metal shoe | BX | 〃 | | | | | | | | | | | | | | | | | | | 6 | 6 |
| Cement | | bag | 120 | 50 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | | 810 |
| Rag | | kg | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 12 | 12 | 12 | 10 | 10 | 10 | | 162 |
| Core box | | pec. | 21 | 19 | 21 | 21 | 22 | 20 | 20 | 19 | 23 | 27 | 25 | 29 | 52 | 60 | 50 | 40 | 34 | 29 | | 532 |
| Board | 3 cm | $m^3$ | | | | | | | | | | | | | | | | | | | 4 | 4 |
| Square timber wire | 24 cm × 24 cm × 300 m | $m^3$ | | | | | | | | | | | | | | | | | | | 8 | 8 |
| Wire | φ10 | kg | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 25 | 25 | 20 | 20 | 20 | 20 | | 370 |

Table 3-1-C(2)

| Description | Specification | Unit | Quantity | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DDH JS-1 | DDH JS-2 | DDH JS-3 | DDH JS-4 | DDH JS-5 | DDH JS-6 | DDH JS-7 | DDH JS-8 | DDH JS-9 | DDH JS-10 | DDH JS-11 | DDH JS-12 | DDH JK-1 | DDH JK-2 | DDH JK-3 | DDH IP-1 | DDH IP-2 | DDH IP-3 | Com. | Total |
| Nail | | kg | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | | 90 |
| Wire rope | 18 ㎜ × 25 m | pec. | | | | | | | | | | | | | | | | | | | 5 | 5 |
| Wire rope | 5 ㎜, WL | pec. | | | | | | | | | | | | | | | | | | | 1,500 | 1,500 |
| Manila rope | 22 ㎜ × 30 m | pec. | | | | | | | | | | | | | | | | | | | 6 | 6 |
| Pump packing | | set | | | | | | | | | | | | | | | | | | | 4 | 4 |
| Pump liner | | 〃 | | | | | | | | | | | | | | | | | | | 2 | 2 |
| Pump piston packing | | 〃 | | | | | | | | | | | | | | | | | | | 4 | 4 |
| Water swivel packing | | 〃 | | | | | | | | | | | | | | | | | | | 6 | 6 |
| Water swivel bearing | | pec. | | | | | | | | | | | | | | | | | | | 4 | 4 |
| V-belt | For engine | set | | | | | | | | | | | | | | | | | | | 6 | 6 |
| V-belt | For drill machine | 〃 | | | | | | | | | | | | | | | | | | | 3 | 3 |
| Casing pipe | 112 ㎜ | pec. | | | | | | | | | | | | | | | | | | | 4 | 4 |
| Casing pipe | NX | 〃 | | | | | | | | | | | | | 6 | 3 | 10 | | | 2 | | 21 |
| Casing pipe | BX | 〃 | | | | | | | | | | | | | | | | | | | 11 | 11 |

## CHAPTER 3 DRILLING OPERATIONS

### 3-1 Preparatory Works

Various preparatory works were put into practice according to the time-table to commence the drilling work on November 30 under the current drilling programme.

The equipment and materials that had been kept in custody in Monywa were checked and the proposed drilling sites were inspected by 7 drilling technicians immediately upon their arrival at Monywa on November 24, and the transportation of 2 sets of drilling machines and materials was commenced on November 26.

The first drilling site DDH JS-1 was about 400 meters away from the base camp, and required only partial repairs of the road before the equipment was brought in by truck. DDH JS-2 site was located in a paddyfield, and the transportation of the equipment was delayed due to the heavy raining that lasted for several days before the scheduled date of transportation, until the drill could be towed into the site by a bulldozer provided by the Burman Party after the road repairs and the site preparations were completed. Other equipment and materials were brought in by truck.

As for the supply of drilling water, arrangements were made to use water from a well in the Burmese Camp, raised through a 550 meter pipeline laid down from there to a water tank on the top of Sabedaung hill by a NAS-4 type pump. Plastic pipeline was used to supply water for each drilling site from the water tank. For areas other than Sabedaung, water supply was available from wells or springs found within a 100 - 500 meter distanse from each drilling site by installing there necessary pumping facilities respectively.

3-2 Moving Operations

The drilling equipment and materials were transported by truck and bulldozer. Moving operations from site to site are as shown in the table below.

Moving Operation

| Item | Hole No. | DDHJS-1 | | DDHJS-2 | | DDHJS-3 | | DDHJS-4 | | DDHJS-5 | | DDHJS-6 | | DDHJS-7 | | DDHJS-8 | | DDHJS-9 | | DDHJS-10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moving Operation | in | 26th Nov. '73 | | 26th Nov. '73 | | 5th Dec. '73 | | 11th Dec. '73 | | 10th Dec. '73 | | 17th Dec. '73 | | 17th Dec. '73 | | 28th Dec. '73 | | 29th Dec. '73 | | 18th Jan. '74 | |
| | | 29th Nov. '73 | | 2nd Dec. '73 | | 6th Dec. '73 | | 12th Dec. '73 | | 11th Dec. '73 | | 19th Dec. '73 | | 19th Dec. '73 | | 2nd Jan. '74 | | 6th Jan. '74 | | 21st Jan. '74 | |
| | out | 5th Dec. '73 | | 10th Dec. '73 | | 10th Dec. '73 | | 17th Dec. '73 | | 16th Dec. '73 | | 25th Dec. '73 | | 27th Dec. '73 | | 14th Jan. '74 | | 14th Jan. '74 | | 30th Jan. '74 | |
| | | | | | | | | | | | | 27th Dec. '73 | | 28th Dec. '73 | | 17th Jan. '74 | | 16th Jan. '74 | | 31st Jan. '74 | |
| Preparations | | Day | Man-day | Day | Man-day | Day | Man-day | Day | Man-day | Day | Man-day | Day | Man-day | Day | Man-day | Day | Man-day | Day | Man-day | Day | Man-day |
| | Access Road | 1 | 13 | 2.5 | 13 | 0.5 | 4 | 0.5 | 6 | 0.5 | 6 | 0.5 | 7 | 0.5 | 8 | 1 | 15 | 1 | 16 | 0.5 | 10 |
| | Haulage | 1 | 13 | 1.5 | 59 | 0.5 | 4 | 0.5 | 7 | 0.5 | 6 | 0.5 | 8 | 0.5 | 9 | 1 | 15 | 1 | 16 | 1 | 15 |
| | Installations | 1 | 13 | 2 | 26 | 1 | 10 | 1 | 13 | 1 | 13 | 1 | 15 | 1 | 15 | 1 | 15 | 2 | 32 | 1.5 | 20 |
| | Water Pipe | 1 | 13 | 1 | 12 | | | | | | | | | | | | | | | | |
| | Test Run. etc. | | | | | | | | | | | | | | | | | | | | |
| | Total | 4 | 52 | 7 | 110 | 2 | 18 | 2 | 26 | 2 | 25 | 2 | 30 | 2 | 32 | 3 | 45 | 4 | 64 | 3 | 45 |
| Removal | Dismantling | 0.5 | 7 | 1 | 14 | 1 | 13 | 1 | 13 | 1 | 12 | 2 | 30 | 2 | 32 | 2 | 30 | 2 | 32 | 2 | 30 |
| | Pipe Removal | | | | | | | | | | | | | | | 1 | 15 | | | | |
| | Haulage | | | | | | | | | | | | | | | | | | | | |
| | Road Reinstatement | | | | | | | | | | | | | | | | | | | | |
| | Others | | | | | | | | | | | | | | | | | | | | |
| | Total | 0.5 | 7 | 1 | 14 | 1 | 13 | 1 | 13 | 1 | 12 | 2 | 30 | 2 | 32 | 3 | 45 | 2 | 32 | 2 | 30 |
| Grand Total | | 4.5 | 59 | 8 | 124 | 3 | 31 | 3 | 39 | 3 | 37 | 4 | 60 | 4 | 64 | 6 | 90 | 6 | 96 | 5 | 75 |

| Item | Hole No. | DDHJS-11 | | DDHJS-12 | | DDHJK-1 | | DDHJK-2 | | DDHJK-3 | | DDHIP-1 | | DDHIP-2 | | DDHIP-3 | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moving Operation | in | 17th Jan. '74 | | 1st Feb. '74 | | 31st Jan. '74 | | 23rd Feb. '74 | | 9th Mar. '74 | | 14th Feb. '74 | | 26th Feb. '74 | | 9th Mar. '74 | | | | |
| | | 20th Jan. '74 | | 4th Feb. '74 | | 4th Feb. '74 | | 25th Feb. '74 | | 12th Mar. '74 | | 17th Feb. '74 | | 27th Feb. '74 | | 12th Mar. '74 | | | | |
| | out | 29th Jan. '74 | | 12th Feb. '74 | | 21st Feb. '74 | | 8th Mar. '74 | | 24th Mar. '74 | | 25th Feb. '74 | | 7th Mar. '74 | | 21st Mar. '74 | | | | |
| | | 30th Jan. '74 | | 13th Feb. '74 | | 22nd Feb. '74 | | | | 30th Mar. '74 | | | | 8th Mar. '74 | | 30th Mar. '74 | | | | |
| Preparation | | Day | Man-day | Day | Man-day | Day | Man-day | Day | Man-day | Dat | Man-day | Day | Man-day | Day | Man-day | Day | Man-day | | Day | Man-day |
| | Access Road | 0.5 | 10 | 1 | 15 | 1 | 14 | 0.5 | 7 | 0.5 | 7 | | | | | 0.5 | 6 | | 12.5 | 157 |
| | Haulage | 1 | 18 | 1 | 15 | 1.5 | 21 | 1 | 14 | 1 | 14 | 1 | 13 | 1 | 13 | 1 | 13 | | 16.5 | 273 |
| | Installations | 1.5 | 20 | 1 | 15 | 1.5 | 21 | 1 | 16 | 1.5 | 21 | 1.5 | 19 | 1 | 13 | 1.4 | 17 | | 22.9 | 314 |
| | Water Pipe | | | | | | | | | | | 0.5 | 7 | | | 0.1 | 3 | | 2.6 | 35 |
| | Test Run. etc. | | | | | | | | | | | | | | | | | | | |
| | Total | 3 | 48 | 3 | 45 | 4 | 56 | 2.5 | 37 | 3 | 42 | 3 | 39 | 2 | 26 | 3 | 39 | | 54.5 | 779 |
| Removal | Dismantling | 2 | 32 | 1 | 13 | 2 | 28 | 1 | 14 | 2 | 28 | 1 | 13 | 1.5 | 19 | 2.3 | 29 | | 27.3 | 389 |
| | Pipe Removal | | | | | | | | | 0.3 | 3 | | | | | 0.2 | 4 | | 1.5 | 22 |
| | Haulage | | | | | | | | | 1 | 12 | | | | | 2 | 26 | | 3 | 38 |
| | Road Reinstatement | | | | | | | | | | | | | | | | | | | |
| | Others | | | | | | | | | 2.7 | 26 | | | | | 3.5 | 30 | | 6.2 | 56 |
| | Total | 2 | 32 | 1 | 13 | 2 | 28 | 1 | 14 | 6 | 69 | 1 | 13 | 1.5 | 19 | 8 | 89 | | 38 | 505 |
| Grand Total | | 5 | 80 | 4 | 58 | 6 | 84 | 3.5 | 51 | 9 | 111 | 4 | 52 | 3.5 | 45 | 11 | 128 | | 92.5 | 1,284 |

3-3 Withdrawing Operations

Immediately after the completion of the drilling of DDH JK-3, the last hole, on March 23, 1973, the withdrawal of the casing pipes and the dismantling operations of the drills, derricks and piping facilities were carried out. All the equipment and materials were then sent back to Monywa for checking in the presence of Burmese official and stored in a designated place for custody.

The whole field operations were completed on March 30, 1973.

3-4 Drilling Works

As stated already in the Section of drilling method, favorable results were obtained in the operations by establishing a drilling method intended particularly for a high core recovering rate in the drilling of soft layers, sheared zones and such layers as requiring special measures to prevent the loss of water as devised from the experiences in the 1972 drilling oper ations. The drilling conditions are summarized as follows.

Except for a broken rod accident in the IP anomalous area, the drilling operations were performed satisfactorily. Namely, in the areas other than the said IP area, 4-3/4" tricone bits were used for the overburden which ranged from 1.60 to 3.00 meters thick 13.00 to 18.00 meters in the IP anomalous area then casing pipes of 112 m/m in diameter and of NX size were inserted down to the required depth, followed further by NQ and BQ wireline drilling. In the lower portion of DDH JS-3, there was a soft layer encountered, casing a part of cores last unavoidably.

But, re-adjusted ratios of the mud-fluid composition proved successful to obtain the core recovery rate of 83%. Aside from a partial loss of water occasioned by fissures, the rocks were uniform in nature, and both the drilling and core recovery rates were satisfactory with comparatively fewer core blocking.

In Kyisindaung south area, there were fissures developed in the depths from 1.60 to 6.30 meters which caused the loss of water and caving necessitating the use of 101 m/m bits and NX casing pipes to enlarge the holes. The drilling was continued by extending the NX casing pipes down to the 6.30 meter depth, but from this point downward it made a good progress, the rocks being of uniform nature.

Three holes were drilled over the IP anomalies. The overburden ranged between 13.00 and 18.00 meters in thickness, and was drilled by 4-3/4" tricone bits to the depth of 1.60 meters, trying thereafter to carry out coring by 101 m/m bits until the ore was reached to investigate the conditions of the overburden, but it was hard to recover cores because of the sand and gravels. NQ and BQ wireline methods were applied to drill below the depth of 18.10 meters, which were found to be a series of extremely soft rocks to the depth of 160.30 meters such as muddy rocks, mudstone, clay, etc., presenting an unstable state of caving caused by the loss of water. This was particularly remarkable in the case of DDH IP-3, giving rise to a broken rod accident due to the said conditions. Various recovery steps were taken, but failed because of the excessively enlarged holes.

The drilling of this portion was continued by NQ wireline method to make coring, then reamed by 101 m/m bits and NX casing pipes inserted down to the required depth, followed by the further insertion of BX casing pipe to drill by BQ wireline method. The rock nature was good and the drilling proceeded satisfactorily.

3-5 Drilling Operations

The drilling operations of the 18 holes bored are as follows.

DDH JS-1 (No. 1)

Used 4-3/4" tricone bit at the start of drilling of the overburden, and on reaching the rock at 3.00 M, 112 m/m and NX casing pipes were inserted. Drilled by NQ wireline method from the depth of 3.00 M to 150.40 M. Rock nature was favorable and drilling progressed satisfactorily except between 33.00 M and 70.00 M where many fissures were encountered causing frequent core-blockings. Completed drilling at the depth of 150.40 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-2 (No. 2)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at the depth of 3.00 M, then 112 m/m casing pipe was inserted. Drilled by NQ wireline method to the depth of 51.00 M, but at 24.00 M, total loss of water happened, requiring the hole to be enlarged by 101.00 m/m bit to the depth of 24.00 M and NX casing pipe inserted. Continued drilling by BQ wireline method from 51.00 M to

151.00 M. Rock nature was favorable and drilling proceeded satisfactorily with a little core-blocking. Completed drilling at the depth of 151.10 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-3 (No. 3)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at 1.60 M, then 112 m/m casing pipe was inserted. Drilled by 101 m/m bit from 1.60 M to 3.00 M, and NX casing pipe was inserted. Rocks were homogeneous and drilled satisfactorily with only slight loss of water near the depths of 24.00 M and 27.00 M. Completed drilling at the depth of 150.70 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-4 (No. 4)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at the depth of 3.00 M, then 112 m/m casing pipe was inserted. Drilled by NQ wireline method from 3.00 M to 151.60 M, during which loss of water happened at 24.50 M, but was successfully prevented further loss by pouring Telstop into the hole. Rocks were homogeneous on the whole and drilling made a good progress with a little coreblocking. Completed drilling at the depth of 151.60 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-5 (No. 5)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at 1.60 M, then 112 m/m casing pipe was inserted. Drilled by 101 m/m bit to the depth of 3.00 M and NX casing pipe was inserted, thereafter continuing drilling by NQ wireline method. Rocks were homogeneous and drilled satisfactorily with a little core-blocking. Completed drilling at the depth of 151.00 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-6 (No. 6)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at 1.60 M, then 112 m/m casing pipe was inserted. Drilled by 101 m/m bit to the depth of 3.00 M and inserted NX casing pipe, thereafter continuing drilling by NQ wireline method. Encountered soft and fragile layers near the depth of 43.00 M and 59.00 M, which caused cavings and required BX casing pipe to be inserted at 84.90 M, from the point downward drilled by BQ wireline method. Apart from the said fragile portion, the drilling made a good progress with the fewer core-blocking. Completed drilling at the depth of 150.40 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-7 (No. 7)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at the depth of 3.00 M, then 112 m/m casing pipe was inserted, thereafter drilling by NQ wireline method. At 20.20 M, total loss of water happened, but Telstop pouring brought little effect and the hole had to be enlarged by NX casing pipe to the depth of 21.00 M.

Continued drilling by NQ wireline method to 99.20 M and, after BX casing pipe was inserted, shifted to BQ wireline method. Except for partial caving at the portion of water loss, the subsequent drilling was satisfactory. Completed drilling at the depth of 151.00 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-8 (No. 8)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at the depth of 1.60 M, then inserted 112 m/m casing pipe and drilled by 101 m/m bit to 3.00 M and by NQ wireline method to 90.10 M after insertion of NX casing pipe, which was succeeded by BX casing pipe. Drilling by BQ wireline method between the depth of 90.10 M and 151.00 M ran across soft portions from 99.00 M to 101.00 M and 109.00 M to 140.00 M, but succeeded to prevent the loss of cores by altering the ratio of mud-fluid composition. Completed drilling at the depth of 151.00 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-9 (No. 9)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at the depth of 3.10 M, then 112 m/m casing pipe was inserted, continuing drilling by NQ wireline method to the depth of 84.10 M. During the drilling, these was a sudden loss of water near 17.80 M, and the hole was enlarged by 101 m/m bit to the depth of 19.80 M, extending NX casing pipe down there. BX casing pipe was inserted at 84.10 M, thereafter drilled by BQ wireline method.

Rock were homogeneous and drilled satisfactorily. Completed drilling at 151.50 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-10 (No. 10)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at 1.60 M, then 112 m/m casing pipe was inserted, drilling to the depth of 91.50 M by NQ wireline method. Slight loss of water happened at 15.60 M. BX casing pipe was inserted at 91.50 M and continued drilling by BQ wireline method. Rocks were good on the whole. Drilling made a good progress and completed at the depth of 151.00 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-11 (No. 11)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at 3.00 M, then 112 m/m casing pipe was inserted. While drilling thereafter by NQ wireline method, the hole caved near the depth of 33.00 M and was enlarged down to the same depth by inserting NX casing pipe. Drilled to the depth of 90.60 M by NQ wireline method, then BX casing pipe was inserted, continuing drilling to the depth of 151.60 M by BQ wireline method. Except for the caved portion said above, rocks were good and drilled satisfactorily. Completed drilling at the depth of 151.60 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JS-12 (No. 12)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at 6.10 M, then 112 m/m casing pipe was inserted and drilled by 101 m/m bit to the depth of 19.50 M, thereafter inserted NX casing pipe, continuing drilling by NQ wireline method. Rocks were homogeneous and drilled satisfactorily. Completed drilling at the depth of 151.00 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JK-1 (No. 13)

Used 4-3/4" tricone bit fromthe start of drilling of the overburden until the rock was reached at the depth of 3.00 M, then 112 m/m casing pipe was inserted, drilling thereafter by NQ wireline method. But, the rock nature continued unfavorable to the depth of 35.00 M and caused caving requiring to enlarge the hole by 101 m/m bit to the depth of 36.00 M and insert NX casing pipe. Thereafter drilled by NQ wireline method to 201.60 M, inserted BX casing pipe and continued drilling by BQ wireline method. Completed drilling at the depth of 301.60 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JK-2 (No. 14)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at the depth of 3.60 M, then inserted 112 m/m casing pipe and drilled by NQ wireline method. During the drilling, the total loss of water occurred at the depth of 20.10 M and the hole had to be enlarged by 101 m/m bit and NX casing pipe inserted to 25.50 M. Thereafter continued drilling by NQ wireline method. Rocks were homogeneous and drilled satisfactorily. Completed drilling at the depth of 301.10 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH JK-3 (No. 15)

Used 4-3/4" tricone bit from the start of drilling of the overburden until the rock was reached at the depth of 1.60 M, then 112 m/m casing pipe was inserted. During the drilling from 1.60 M to 85.50 M, the operations were extremely difficult due to the heavy caving and loss of water, and had to proceed with NX casing pipe to enlarge the hole and by extending it to the depth of 63.00 M. Thereafter drilled by NQ wireline method to 142.50 M, inserted BX casing pipe and continued drilling by BQ wireline method. Rocks had many fissures, frequently causing core-blocking and hard drilling. Completed drilling at the depth of 301.60 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH IP-1 (No. 16)

Used 4-3/4" tricone bit at the start of drilling, and at the depth of 1.60 M, 112 m/m casing pipe was inserted with the view to recovering core from the overburden. Drilled by 101 m/m bit to the depth of 18.10 M and NX casing pipe inserted, thereafter continued drilling by NQ wireline method. There were many fissures from 66.00 M to 84.00 M and, therefore, heavy core-blocking, but in other portions, rocks were homogeneous and drilled satisfactorily. Completed drilling at the depth of 201.20 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH IP-2 (No. 17)

Used 4-3/4" tricone bit at the start of drilling, and at the depth of 1.60 M inserted 112 m/m casing pipe, drilling by 101 m/m bit until the rock was reached at 13.50 M, then NX casing pipe was inserted and drilled by NQ wireline method to the depth of 135.00 M. After BX casing pipe was inserted, continued drilling by BQ wireline method. Rocks were homogeneous and drilled satisfactorily. Completed drilling at the depth of 201.00 M with the object duly achieved. Mud-fluid "Chromenite" was used for the entire length of the hole.

DDH IP-3 (No. 18)

Used 4-3/4" tricone bit at the start of drilling, and at 1.60 M, 112 m/m casing pipe was inserted, thereafter drilling by 101 m/m bit to the depth of 16.40 M, then NX casing pipe inserted. Continued drilling from 16.40 M downward by NQ wireline method, but the operations being difficult with excessive cavings due to the soft and fragile layer, the hole had to be enlarged by NX casing shoe, and when drilling at 160.30 M, the rod was broken at the point of 141.00 M. Various attempts failed to recover the broken rod as the hole was enlarged owing to the soft layer. BX casing pipe was inserted to the depth of 147.50 M, continuing drilling by BQ wireline method and completed at the depth of 200.60 M with the object duly achieved. Rocks were extremely soft, consisting principally of sand, gravel, muddy rock, mudstone, etc. and making it difficult to obtain a high recovery rate of cores. Mud-fluid "Chromenite" was used for the entire length of the hole.

## 3-6 Operational Records and Analysis

### (1) Analysis of Working Time

As shown in Fig. 3-2, of Total Working Time, Drilling Work Time accounts for 75.5%, which includes Drilling Time in the proportion of 52.4% and Ancillary Work of 22.3% respectively to the total, the last consisting mainly of drilling preparations, post-drilling work and recess, and also of others in the proportion of 11.4% to the total such as hole enlarging, casing insertion, cementation, etc.

Moving operations occupied a comparatively low proportion of 24.5% to Total Working Time because the main equipment could be moved by a bulldozer as previously stated.

Throughout the operation, the proportions of working time by each work element were held in balance on the whole.

### (2) Drilling Results

As shown in Table 3-2(A), the drilling length per shift was 13.77 meters for the total works and 14.27 meters for the net drilling operations, showing higher rates than originally expected.

### (3) Core Recovery Rate

Table 3-3 shows high rates of core recovery obtained, 95.2% on the overall average and 98.3% excluding the overburden. High rates of recovery of approximately same percentages were also shown in the comparative results by rocks, excluding the portions of porous rhyolite in DDH JS-8 and of fragile sandstone, clay, etc. in IP-3.

Table 3-2 (A) Analysis of Working Time

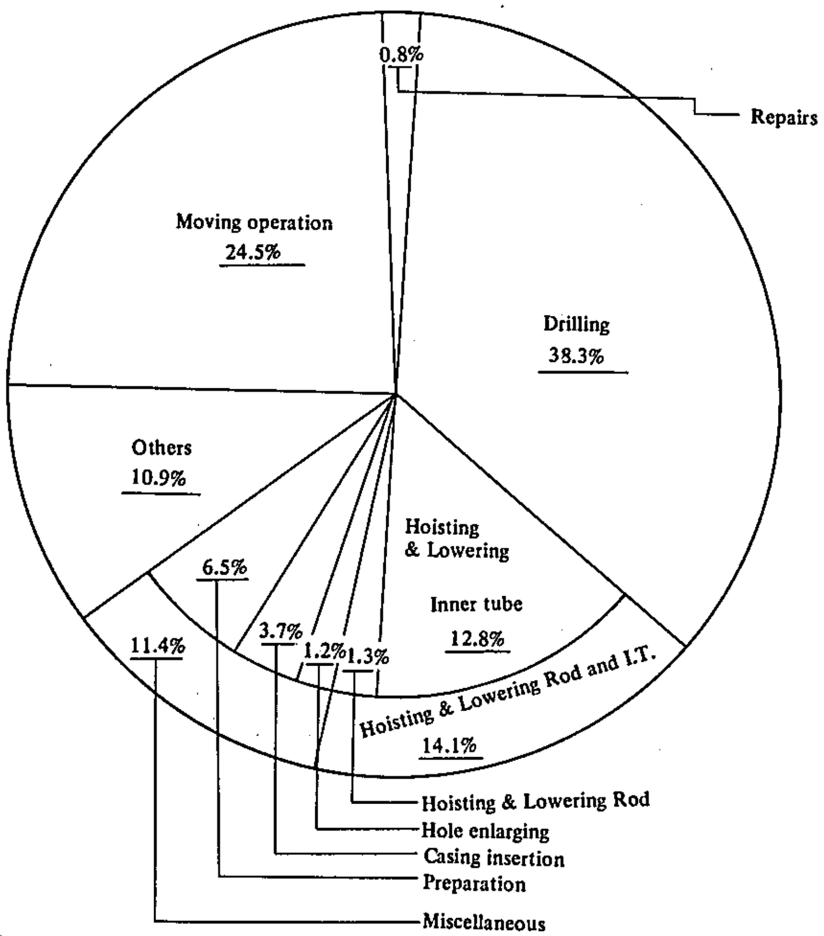


Table 3-2(B) Analysis of Workingtime for Each Borehole

| Borehole | Drilling | Hoisting & Lowering Rod and I.T. | | Miscellaneous | | | Repairs | Others | Moving Operation | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rod | Inner Tube | Casing Insertion | Hole enlarging | Others | | | | |
| DDH JS − 1 | 40°00′ | °50′ | 11°00′ | °30′ | °−′ | 7°00′ | °−′ | 8°40′ | 32°00′ | 100°00′ |
| JS − 2 | 39.10 | 50 | 9.10 | 1.50 | 7.40 | 19.20 | − | 18.00 | 56.00 | 152.00 |
| JS − 3 | 46.50 | 50 | 8.40 | 10 | − | 7.30 | − | 9.00 | 15.00 | 88.00 |
| JS − 4 | 53.20 | 50 | 14.50 | 10 | − | 7.50 | − | 14.00 | 21.00 | 112.00 |
| JS − 5 | 49.20 | 50 | 14.10 | 30 | − | 12.10 | − | 13.00 | 19.00 | 109.00 |
| JS − 6 | 47.50 | 30 | 14.00 | 3.50 | − | 6.50 | − | 11.30 | 28.30 | 113.00 |
| JS − 7 | 45.30 | 1.30 | 13.20 | 6.40 | 3.30 | 6.30 | − | 15.00 | 28.00 | 120.00 |
| JS − 8 | 58.00 | 1.20 | 25.30 | 5.00 | − | 12.00 | 3.10 | 21.00 | 42.00 | 168.00 |
| JS − 9 | 53.10 | 2.30 | 13.40 | 6.00 | − | 22.40 | − | 20.00 | 42.00 | 160.00 |
| JS −10 | 51.30 | 1.50 | 14.10 | 2.00 | − | 12.20 | − | 17.00 | 37.10 | 136.00 |
| JS −11 | 51.40 | 2.30 | 16.30 | 10.20 | 1.00 | 9.30 | − | 17.30 | 35.00 | 144.00 |
| JS −12 | 48.50 | 30 | 15.10 | 4.10 | 2.00 | 6.50 | − | 14.30 | 28.00 | 120.00 |
| JK − 1 | 100.40 | 4.50 | 42.00 | 10.10 | 2.00 | 10.20 | − | 28.00 | 42.00 | 240.00 |
| JK − 2 | 83.30 | 1.40 | 32.30 | 7.00 | − | 14.50 | − | 16.00 | 28.30 | 184.00 |
| JK − 3 | 86.20 | 5.00 | 39.00 | 15.50 | 12.30 | 3.50 | − | 23.30 | 70.00 | 256.00 |
| IP − 1 | 59.00 | 2.40 | 22.30 | 5.10 | 30 | 3.40 | − | 14.30 | 28.00 | 136.00 |
| IP − 2 | 58.50 | 3.30 | 18.10 | 2.40 | 20 | 10.30 | − | 14.00 | 28.00 | 136.00 |
| IP − 3 | 56.00 | 3.00 | 19.50 | 17.00 | 2.40 | 2.30 | 19.00 | 19.00 | 77.00 | 216.00 |
| | | | | | | | | | | |
| | 38.3% | 1.3% | 12.8% | 3.7% | 1.2% | 6.5% | 0.8% | 10.9% | 24.5% | 100.0% |
| Total | | 35.30 | 344.10 | 99.00 | 32.10 | 176.10 | | | | |
| | 1,029.30 | 379.40 | | 307.20 | | | 22.10 | 294.10 | 657.10 | 2,690.00 |

| Drill Hole No. | Type of Machine | Drilling Period | Drilled Length | Core | | Number of Drilling Shift | | | Drilling Speed | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length | Recovery | Drilling | Casing etc. | Total | *m/shift | **m/shift |
| | | | m | m | % | shift | shift | shift | m | m |
| DDHJ S−1 | TGM−2C | Com. 30th Nov. 1973<br>Fin. 4th Dec. 1973 | 150.40 | 142.50 | 94.7 | 8 | | 8 | 18.80 | 18.80 |
| DDHJ S−2 | TEL−3B | Com. 3rd Dec. 1973<br>Fin. 9th Dec. 1973 | 151.10 | 146.80 | 97.2 | 10 | 1 | 11 | 13.74 | 15.10 |
| DDHJ S−3 | TGM−2C | Com. 7th Dec. 1973<br>Fin. 9th Dec. 1973 | 150.70 | 149.10 | 98.9 | 9 | | 9 | 16.74 | 16.74 |
| DDHJ S−4 | TEL−3B | Com. 13th Dec. 1973<br>Fin. 16th Dec. 1973 | 151.60 | 148.60 | 98.0 | 11 | | 11 | 13.78 | 13.78 |
| DDHJ S−5 | TGM−2C | Com. 12th Dec. 1973<br>Fin. 15th Dec. 1973 | 151.00 | 149.40 | 98.9 | 11 | | 11 | 13.72 | 13.72 |
| DDHJ S−6 | TGM−2C | Com. 20th Dec. 1973<br>Fin. 24th Dec. 1973 | 150.40 | 141.90 | 94.3 | 10 | | 10 | 15.04 | 15.04 |
| DDHJ S−7 | TEL−3B | Com. 20th Dec. 1973<br>Fin. 26th Dec. 1973 | 151.00 | 148.00 | 98.0 | 11 | | 11 | 13.72 | 13.72 |
| DDHJ S−8 | TGM−2C | Com. 3rd Jan. 1974<br>Fin. 13th Jan. 1974 | 151.00 | 126.60 | 83.8 | 13 | | 13 | 11.61 | 11.61 |
| DDHJ S−9 | TEL−3B | Com. 7th Jan. 1974<br>Fin. 13th Jan. 1974 | 151.50 | 148.40 | 97.9 | 14 | | 14 | 10.82 | 10.82 |
| DDHJ S−10 | TGM−2C | Com. 22nd Jan. 1974<br>Fin. 29th Jan. 1974. | 151.00 | 149.40 | 98.9 | 12 | | 12 | 12.58 | 12.58 |
| DDHJ S−11 | TEL−3B | Com. 21st Jan. 1974<br>Fin. 28th Jan. 1974 | 151.60 | 148.60 | 98.0 | 12 | 1 | 13 | 11.66 | 12.63 |
| DDHJ S−12 | TGM−2C | Com. 5th Feb. 1974<br>Fin. 11th Feb. 1974 | 151.00 | 139.70 | 92.5 | 11 | | 11 | 13.72 | 13.72 |
| DDHJ K−1 | TEL−3B | Com. 5th Feb. 1974<br>Fin. 20th Feb. 1974 | 301.60 | 292.10 | 96.8 | 23.5 | 0.5 | 24 | 12.56 | 12.83 |
| DDHJ K−2 | TEL−3B | Com. 25th Feb. 1974<br>Fin. 7th Mar. 1974 | 301.10 | 296.90 | 98.6 | 18.5 | 0.5 | 19 | 15.84 | 16.27 |
| DDHJ K−3 | TEL−3B | Com. 13th Mar. 1974<br>Fin. 23rd Mar. 1974 | 301.60 | 288.00 | 95.5 | 19 | 3 | 22 | 13.70 | 15.87 |
| DDHI P−1 | TGM−2C | Com. 18th Feb. 1974<br>Fin. 24th Feb. 1974 | 201.20 | 195.80 | 97.3 | 13 | | 13 | 15.47 | 15.47 |
| DDHI P−2 | TGM−2C | Com. 28th Feb. 1974<br>Fin. 7th Mar. 1974 | 201.00 | 195.20 | 97.1 | 12.5 | 0.5 | 13 | 15.46 | 16.08 |
| DDHI P−3 | TGM−2C | Com. 13th Mar. 1974<br>Fin. 20th Mar. 1974 | 200.60 | 153.40 | 76.5 | 14 | 2 | 16 | 12.53 | 14.32 |
| Total | 18 Holes | Biot. 30th Nov. 1973<br>Fin. 23rd May, 1974 | 3,319.40 | 3,160.40 | 95.2 | 232.5 | 8.5 | 241 | 13.77 | 14.27 |

Notes: Com. : Commenced    * Drilled length per one shift covering total works conducted.
Fin. : Finished    ** Drilled length per one shift covering net drilling operations.

SUMMARY RECORD OF DRILLING RESULTS

Table 3-4 DDH. JS-1

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 26th Nov. 1973~29th Nov. 1973 | 4 | 4 | - | 52 |
| | Drilling | 30th Nov. 1973~4th Dec. 1973 | 5 | 5 | - | 46 |
| | Removing | 5th Dec. 1973 | 0.5 | 0.5 | - | 7 |
| | TOTAL | 26th Nov. 1973~5th Dec. 1973 | 9.5 | 9.5 | - | 105 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | | 150.00 m | | |
| | Increase or Decrease in Length | | 0.40 m | Core Length | 142.50 m |
| | Length Drilled | | 150.40 m | Core Recovery | 94.7% |
| Working Time | Drilling | | 40°00' | 58.8% | 40.0% |
| | Hoisting & Lowering Rod | | 0°50' | 1.2% | 0.8% |
| | Hoisting & Lowering I. T. | | 11°00' | 16.2 | 11.0 |
| | Miscellaneous | | 7°30' | 11.0 | 7.5 |
| | Repairing | | - | - | - |
| | Others | | 8°40' | 12.8 | 8.7 |
| | TOTAL | | 68°00' | 100 % | 68.0% |
| | Re-moving | Preparation | 28°00' | | 28.0 |
| | | Moving | 4°00' | | 4.0 |
| | G. TOTAL | | 100°00' | | 100 |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 92.5% | 92.5% | 400~500 | | |
| 100~200 | 99.4 | 94.7 | 500~600 | | |
| 200~300 | - | - | 600~700 | | |
| 300~400 | | | 700~800 | | |

Efficiency of Drilling

| | |
|---|---|
| 150.40 m/Work Period | 15.83 m/Day |
| 150.40 m/Working Days | 15.83 m/Day |
| 150.40 m/Drilling Period | 30.08 m/Day |
| 150.40 m/Net Drilling Days | 30.08 m/Day |
| | |
| Total Workers/ 150.40 m | 0.698 Shift |
| Total Drilling Workers/150.40 m | 0.305 Shift |

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 3.00m | 2.0 % | 100 % |
| | NX 3.00m | 2.0 | 100 |
| | BX - | - | - |
| | | | |

| | |
|---|---|
| Hoisting & Lowering Rod 2 Times | Hoisting & Lowering I. T. 66 Times |

Remarks

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-5 DDH. JS-2

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 26th Nov. 1973 ~ 2nd Dec. 1973 | 7 | 7 | - | 110 |
| | Drilling | 3rd Dec. 1973 ~ 9th Dec. 1973 | 7 | 6 | 1 | 72 |
| | Removing | 10th Dec. 1973 | 1 | 1 | - | 14 |
| | TOTAL | 26th Nov. 1973 ~ 10th Dec. 1973 | 15 | 14 | 1 | 196 |

| | | | | |
|---|---|---|---|---|
| Drilling Length | Planned Length | 150.00 m | | |
| | Increase or Decrease in Length | 1.10 m | Core Length | 146.80 m |
| | Length Drilled | 151.10 m | Core Recovery | 97.2 % |
| Working Time | Drilling | 39°10' | 40.8 % | 25.8 % |
| | Hoisting & Lowering Rod | 0°50' | 0.9 | 0.5 |
| | Hoisting & Lowering I. T. | 9°10' | 9.5 | 6.0 |
| | Miscellaneous | 28°50' | 30.0 | 19.0 |
| | Repairing | - | - | - |
| | Others | 18°00' | 18.8 | 11.9 |
| | TOTAL | 96°00' | 100 % | 63.2 % |
| | Re-moving: Preparation | 49°00' | | 32.2 |
| | Re-moving: Moving | 7°00' | | 4.6 |
| | G. TOTAL | 152°00' | | 100 % |

**Core Recovery for 100m Section**

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 95.6 % | 95.6 % | 400~500 | | |
| 100~200 | 100 | 97.2 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

**Efficiency of Drilling**

| | |
|---|---|
| 151.10 m/Work Period | 10.07 m/Day |
| 151.10 m/Working Days | 10.79 m/Day |
| 151.10 m/Drilling Period | 21.58 m/Day |
| 151.10 m/Net Drilling Days | 25.18 m/Day |
| | |
| Total Workers/ 151.10 m | 1.297 Shift |
| Total Drilling Workers/ 151.10 m | 0.476 Shift |

| | |
|---|---|
| Hoisting & Lowering Rod 1 Times | Hoisting & Lowering I. T. 55 Times |

Remarks

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 3.00m | 1.9 % | 100 % |
| | NX 24.60m | 16.3 | 100 |
| | BX 51.00m | 33.8 | 100 |
| | | | |

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-6 DDH. JS-3

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 5th Dec. 1973 ~ 6th Dec. 1973 | 2 | 2 | - | 18 |
| | Drilling | 7th Dec. 1973 ~ 9th Dec. 1973 | 3 | 3 | - | 40 |
| | Removing | 10th Dec. 1973 | 1 | 1 | - | 13 |
| | TOTAL | 5th De. 1973 ~ 10th De. 1973 | 6 | 6 | - | 71 |

| | | | | |
|---|---|---|---|---|
| Drilling Length | Planned Length | 150.00 m | | |
| | Increase or Decrease in Length | 0.70 m | Core Length | 149.10 m |
| | Length Drilled | 150.70 m | Core Recovery | 98.9 % |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 98.4 % | 98.4 % | 400~500 | | |
| 100~200 | 100 | 98.9 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

| | | | | | |
|---|---|---|---|---|---|
| Working Time | Drilling | | 46°50' | 64.2 % | 53.2 % |
| | Hoisting & Lowering Rod | | 0°50' | 1.1 | 0.9 |
| | Hoisting & Lowering I. T. | | 8°40' | 11.9 | 9.9 |
| | Miscellaneous | | 7°40' | 10.5 | 8.8 |
| | Repairing | | - | - | - |
| | Others | | 9°00' | 12.3 | 10.2 |
| | TOTAL | | 73°00' | 100 % | 83.0 % |
| | Re-moving | Preparation | 11°00' | | 12.5 |
| | | Moving | 4°00' | | 4.5 |
| | G. TOTAL | | 88°00' | | 100 % |

Efficiency of Drilling

| | |
|---|---|
| 150.70 m /Work Period | 25.11 m/Day |
| 150.70 m /Working Days | 25.11 m/Day |
| 150.70 m /Drilling Period | 50.23 m/Day |
| 150.70 m /Net Drilling Days | 50.23 m/Day |
| | |
| Total Workers/ 150.70 m | 0.471 Shift |
| Total Drilling Workers/ 150.70 m | 0.265 Shift |
| Hoisting & Lowering Rod 1 Times | Hoisting & Lowering I. T. 52 Times |

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 1.60m | 0.9 % | 100 % |
| | NX 3.00m | 2.0 | 100 |
| | BX m | | |
| | | | |

Remarks

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-7 DDH. JS-4

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 11th Dec. 1973 ~ 12th Dec. 1973 | 2 | 2 | - | 26 |
| | Drilling | 13th Dec. 1973 ~ 16th Dec. 1973 | 4 | 4 | - | 52 |
| | Removing | 17th Dec. 1973 | 1 | 1 | - | 13 |
| | TOTAL | 11th Dec. 1973 ~ 17th Dec. 1973 | 7 | 7 | - | 91 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 150.00 m | | | |
| | Increase or Decrease in Length | 1.60 m | Core Length | | 148.60 m |
| | Length Drilled | 151.60 m | Core Recovery | | 98.0 % |
| Working Time | Drilling | | 53°20' | 58.6 % | 47.6 % |
| | Hoisting & Lowering Rod | | 0°50' | 0.9 | 0.7 |
| | Hoisting & Lowering I. T. | | 14°50' | 16.3 | 13.2 |
| | Miscellaneous | | 8°00' | 8.8 | 7.2 |
| | Repairing | | - | - | - |
| | Others | | 14°00' | 15.4 | 12.5 |
| | TOTAL | | 91°00' | 100 % | 81.2 % |
| | Re-moving | Preparation | 14°00' | | 12.5 |
| | | Moving | 7°00' | | 6.3 |
| | G. TOTAL | | 112°00' | | 100 % |

**Core Recovery for 100m Section**

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 97.0 % | 97.0 % | 400~500 | | |
| 100~200 | 100 | 98.9 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

**Efficiency of Drilling**

| | |
|---|---|
| 151.60 m /Work Period | 21.65 m/Day |
| 151.60 m /Working Days | 21.65 m/Day |
| 151.60 m /Drilling Period | 37.90 m/Day |
| 151.60 m /Net Drilling Days | 37.90 m/Day |
| | |
| Total Workers/151.60 m | 0.600 Shift |
| Total Drilling Workers/ 151.60 m | 0.343 Shift |
| Hoisting & Lowering Rod 1 Times | Hoisting & Lowering I. T. 55 Times |

| Casing Pipe Inserted | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| | 112 m/m 3.00 m | 2.0 % | 100 % |
| | NX 3.00 m | 2.0 | 100 |
| | BX m | | |
| | | | |

Remarks

SUMMARY RECORD OF DRILLING RESULTS

Table 3-8 DDH. JS-5

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 10th Dec. 1973 ~ 11th Dec. 1973 | 2 | 2 | - | 25 |
| | Drilling | 12th Dec. 1973 ~ 15th Dec. 1973 | 4 | 4 | - | 49 |
| | Removing | 16th Dec 1973 | 1 | 1 | - | 12 |
| | TOTAL | 10th Dec. 1973 ~ 16th Dec. 1973 | 7 | 7 | - | 86 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 150.00 m | | | |
| | Increase or Decrease in Length | 100 m | Core Length | 149.40 m | |
| | Length Drilled | 151.00 m | Core Recovery | 98.9 % | |
| Working Time | Drilling | 49°20' | 54.8 % | 45.3 % | |
| | Hoisting & Lowering Rod | 0°50' | 0.9 | 0.8 | |
| | Hoisting & Lowering I. T. | 14°10' | 15.8 | 13.0 | |
| | Miscellaneous | 12°40' | 14.1 | 11.6 | |
| | Repairing | - | - | - | |
| | Others | 13°00' | 14.4 | 11.9 | |
| | TOTAL | 90°00' | 100 % | 82.6 % | |
| | Re-moving | Preparation | 12°00' | | 11.0 |
| | | Moving | 7°00' | | 6.4 |
| | G. TOTAL | 109°00' | | 100 % | |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 98.4 % | 98.4 % | 400~500 | | |
| 100~200 | 100 | 98.9 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

Efficiency of Drilling

| | |
|---|---|
| 151.00 m /Work Period | 21.57 m/Day |
| 151.00 m /Working Days | 21.57 m/Day |
| 151.00 m /Drilling Period | 37.75 m/Day |
| 151.00 m /Net Drilling Days | 37.75 m/Day |
| | |
| Total Workers/ 151.00 m | 0.569 Shift |
| Total Drilling Workers/ 151.00 m | 0.324 Shift |
| Hoisting & Lowering Rod 1 Times | Hoisting & Lowering I. T. 57 Times |

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 1.60 m | 1.1 % | 100 % |
| | NX 3.00 m | 2.0 | 100 |
| | BX | | |
| | | | |

Remarks

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-9 DDH. JS-6

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 17th Dec. 1973 ~ 19th Dec. 1973 | 3 | 2 | 1 | 30 |
| | Drilling | 20th Dec. 1973 ~ 24th Dec. 1973 | 5 | 5 | - | 75 |
| | Removing | 25th Dec. 1973 ~ 27th Dec. 1973 | 3 | 2 | 1 | 30 |
| | TOTAL | 17th Dec. 1973 ~ 27th Dec. 1973 | 11 | 9 | 2 | 135 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 150.00 m | | | |
| | Increase or Decrease in Length | 0.40 m | Core Length | 141.90 m | |
| | Length Drilled | 150.40 m | Core Recovery | 94.3 % | |
| Working Time | Drilling | | 47°50' | 56.6 % | 42.3 % |
| | Hoisting & Lowering Rod | | 0°30' | 0.6 | 0.5 |
| | Hoisting & Lowering I. T. | | 14°00' | 16.6 | 12.4 |
| | Miscellaneous | | 10°40' | 12.6 | 9.4 |
| | Repairing | | - | - | - |
| | Others | | 11°30' | 13.6 | 10.2 |
| | TOTAL | | 84°30' | 100 % | 74.8 % |
| | Re-moving | Preparation | 14°30' | | 12.8 |
| | | Moving | 14°00' | | 12.4 |
| | G. TOTAL | | 113°00' | | 100 % |
| Casing Pipe Inserted | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe | | |
| | 112 m/m 3.00 m | 2.0 % | 100 % | | |
| | NX 3.00 m | 2.0 | 100 | | |
| | BX | | | | |
| | | | | | |

| Core Recovery for 100m Section | | | | | |
|---|---|---|---|---|---|
| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
| 0~100 | 91.7 % | 91.7 % | 400~500 | | |
| 100~200 | 99.8 | 94.1 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |
| **Efficiency of Drilling** | | | | | |
| 150.40 m /Work Period | | | 13.67 m/Day | | |
| 150.40 m /Working Days | | | 16.71 m/Day | | |
| 150.40 m /Drilling Period | | | 30.08 m/Day | | |
| 150.40 m /Net Drilling Days | | | 30.08 m/Day | | |
| | | | | | |
| Total Workers/150.40 m | | | 0.897 Shift | | |
| Total Drilling Workers/150.40 m | | | 0.498 Shift | | |
| Hoisting & Lowering Rod 1 Times | | | Hoisting & Lowering I. T. 55 Times | | |
| Remarks | | | | | |

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-10 DDH. JS-7

| Drilling Periods | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| | Preparation | 17th Dec. 1973 ~ 19th Dec. 1973 | 3 | 2 | 1 | 32 |
| | Drilling | 20th Dec. 1973 ~ 26th Dec. 1973 | 7 | 6 | 1 | 96 |
| | Removing | 27th Dec. 1973 ~ 28th Dec. 1973 | 2 | 2 | | 32 |
| | TOTAL | 17th Dec. 1973 ~ 28th Dec. 1973 | 12 | 10 | 2 | 160 |

| Drilling Length | | | | |
|---|---|---|---|---|
| Planned Length | 150.00 m | | | |
| Increase or Decrease in Length | 1.00 m | Core Length | 148.00 m | |
| Length Drilled | 151.00 m | Core Recovery | 98.0 % | |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 97.0 % | 97.0 % | 400~500 | | |
| 100~200 | 100 | 98.0 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

| Working Time | | | | |
|---|---|---|---|---|
| Drilling | 45°30' | 49.5 % | 37.9 % |
| Hoisting & Lowering Rod | 1°30' | 1.6 | 1.3 |
| Hoisting & Lowering I. T. | 13°20' | 14.5 | 11.1 |
| Miscellaneous | 16°40' | 18.1 | 13.8 |
| Repairing | - | - | - |
| Others | 15°00' | 16.3 | 12.5 |
| TOTAL | 92°00' | 100 % | 76.6 % |
| Re-moving: Preparation | 14°00' | | 11.7 |
| Re-moving: Moving | 14°00' | | 11.7 |
| G. TOTAL | 120°00' | | 100 % |

Efficiency of Drilling

| | |
|---|---|
| 151.00 m /Work Period | 12.58 m/Day |
| 151.00 m /Working Days | 15.10 m/Day |
| 151.00 m /Drilling Period | 21.57 m/Day |
| 151.00 m /Net Drilling Days | 25.16 m/Day |
| | |
| Total Workers/151.00 m | 1.059 Shift |
| Total Drilling Workers/151.00 m | 0.635 Shift |

| Hoisting & Lowering Rod | Hoisting & Lowering I. T. |
|---|---|
| 1 Times | 57 Times |

Casing Pipe Inserted

| Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|
| 112 m/m 3.00 m | 2.0 % | 100 % |
| NX 21.00 m | 13.9 | 100 |
| BX 99.20 m | 65.7 | 100 |
| | | |

Remarks

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-11 DDH. JS-8

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 28th Dec. 1973 ~ 2nd Jan. 1974 | 6 | 3 | 3 | 45 |
| | Drilling | 3rd Jan. 1974 ~ 13th Jan. 1974 | 11 | 9 | 2 | 135 |
| | Removing | 14th Jan. 1974 ~ 17th Jan. 1974 | 4 | 3 | 1 | 45 |
| | TOTAL | 28th Dec. 1973 ~ 17th Jan. 1974 | 21 | 15 | 6 | 225 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 150.00 m | | | |
| | Increase or Decrease in Length | 1.00 m | Core Length | 126.60 m |
| | Length Drilled | 151.00 m | Core Recovery | 83.8 % |
| Working Time | Drilling | 58°00' | 46.0 % | 34.5 % |
| | Hoisting & Lowering Rod | 1°20' | 1.1 | 0.8 |
| | Hoisting & Lowering I. T. | 25°30' | 20.2 | 15.2 |
| | Miscellaneous | 17°00' | 13.5 | 10.1 |
| | Repairing | 3°10' | 2.5 | 1.9 |
| | Others | 21°00' | 16.7 | 12.5 |
| | TOTAL | 126°00' | 100 % | 75.0 % |
| | Re-moving: Preparation | 21°00' | | 12.5 |
| | Re-moving: Moving | 21°00' | | 12.5 |
| | G. TOTAL | 168°00' | | 100 % |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 88.8 % | 88.8 % | 400~500 | | |
| 100~200 | 74.0 | 83.8 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

Efficiency of Drilling

| | |
|---|---|
| 151.00 m /Work Period | 7.19 m/Day |
| 151.00 m /Working Days | 10.06 m/Day |
| 151.00 m /Drilling Period | 13.72 m/Day |
| 151.00 m /Net Drilling Days | 16.77 m/Day |
| | |
| Total Workers/ 151.00 m | 1.490 Shift |
| Total Drilling Workers/ 151.00 m | 0.894 Shift |
| Hoisting & Lowering Rod 1 Times | Hoisting & Lowering I. T. 95 Times |

Remarks

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 1.60 m | 1.0 % | 100 % |
| | NX 3.00 m | 2.0 | 100 |
| | BX 90.10 m | 59.6 | 100 |
| | | | |

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-12 DDH. JS-9

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 29th Dec. 1973 ~ 6th Jan. 1974 | 9 | 4 | 5 | 64 |
| | Drilling | 7th Jan. 1974 ~ 13th Jan. 1974 | 7 | 7 | - | 112 |
| | Removing | 14th Jan. 1974 ~ 16th Jan. 1974 | 3 | 2 | 1 | 32 |
| | TOTAL | 29th Dec. 1973 ~ 16th Jan. 1974 | 19 | 13 | 6 | 208 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 150.00 m | | | |
| | Increase or Decrease in Length | 1.50 m | Core Length | 148.40 m | |
| | Length Drilled | 151.50 m | Core Recovery | 97.9 % | |
| Working Time | Drilling | 53°10' | 45.1 % | 33.2 % | |
| | Hoisting & Lowering Rod | 2°30' | 2.1 | 1.6 | |
| | Hoisting & Lowering L.T. | 13°40' | 11.6 | 8.6 | |
| | Miscellaneous | 28°40' | 24.3 | 17.9 | |
| | Repairing | - | - | - | |
| | Others | 20°00' | 16.9 | 12.5 | |
| | TOTAL | 118°00' | 100 % | 73.8 % | |
| | Re-moving | Preparation | 21°00' | | 13.1 |
| | | Moving | 21°00' | | 13.1 |
| | G. TOTAL | 160°00' | | 100 % | |

| Casing Pipe Inserted | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| | 112 m/m 3.10 m | 2.0 % | 100 % |
| | NX 18.00 m | 11.9 | 100 |
| | BX 84.10 m | 55.5 | 100 |
| | | | |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 96.5 % | 96.5 % | 400~500 | | |
| 100~200 | 100 | 97.9 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

Efficiency of Drilling

| | |
|---|---|
| 151.50 m /Work Period | 7.97 m/Day |
| 151.50 m /Working Days | 11.65 m/Day |
| 151.50 m /Drilling Period | 21.64 m/Day |
| 151.50 m /Net Drilling Days | 21.64 m/Day |
| | |
| Total Workers/ 151.50 m | 1.372 Shift |
| Total Drilling Workers/ 151.50 m | 0.739 Shift |

| | |
|---|---|
| Hoisting & Lowering Rod 1 Times | Hoisting & Lowering I.T. 57 Times |

Remarks

SUMMARY RECORD OF DRILLING RESULTS

Table 3-13 DDH. JS-10

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 18th Jan. 1974 ~ 21st Jan. 1974 | 4 | 3 | 1 | 45 |
| | Drilling | 22nd Jan. 1974 ~ 29th Jan. 1974 | 8 | 7 | 1 | 105 |
| | Removing | 30th Jan. 1974 ~ 31st Jan. 1974 | 2 | 2 | - | 30 |
| | TOTAL | 18th Jan. 1974 ~ 31st Jan. 1974 | 14 | 12 | 2 | 180 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 150.00 m | | | |
| | Increase or Decrease in Length | 1.00 m | Core Length | 149.40 m | |
| | Length Drilled | 151.00 m | Core Recovery | 98.9 % | |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 98.4 % | 98.4 % | 400~500 | | |
| 100~200 | 100 | 98.4 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

| | | | | | |
|---|---|---|---|---|---|
| Working Time | Drilling | | 51°30' | 52.1 % | 37.9 % |
| | Hoisting & Lowering Rod | | 1°50' | 1.9 | 1.3 |
| | Hoisting & Lowering I. T. | | 14°10' | 14.3 | 10.4 |
| | Miscellaneous | | 14°20' | 14.5 | 10.5 |
| | Repairing | | - | - | - |
| | Others | | 17°00' | 17.2 | 12.5 |
| | TOTAL | | 98°50' | 100 % | 72.7 % |
| | Re-moving | Preparation | 21°00' | | 15.4 |
| | | Moving | 16°10' | | 11.9 |
| | G. TOTAL | | 136°00' | | 100 % |

Efficiency of Drilling

| | |
|---|---|
| 151.00 m /Work Period | 10.78 m/Day |
| 151.00 m /Working Days | 12.58 m/Day |
| 151.00 m /Drilling Period | 18.87 m/Day |
| 151.00 m /Net Drilling Days | 21.57 m/Day |
| | |
| Total Workers/ 151.00 m | 1.192 Shift |
| Total Drilling Workers/ 151.00 m | 0.695 Shift |

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 1.60 m | 1.0 % | 100 % |
| | NX 3.00 m | 2.0 | 100 |
| | BX 91.50 m | 60.6 | 100 |
| | | | |

| | |
|---|---|
| Hoisting & Lowering Rod 1 Times | Hoisting & Lowering I. T. 61 Times |

Remarks

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-14 DDH. JS-11

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 17th Jan. 1974 ~ 20th Jan. 1974 | 4 | 3 | 1 | 48 |
| | Drilling | 21st Jan. 1974 ~ 28th Jan. 1974 | 8 | 7 | 1 | 112 |
| | Removing | 29th Jan. 1974 ~ 30th Jan. 1974 | 2 | 2 | - | 32 |
| | TOTAL | 17th Jan. 1974 ~ 30th Jan. 1974 | 14 | 12 | 2 | 192 |

| | | | | |
|---|---|---|---|---|
| Drilling Length | Planned Length | 150.00 m | | |
| | Increase or Decrease in Length | 1.60 m | Core Length | 148.60 m |
| | Length Drilled | 151.60 m | Core Recovery | 98.0 % |
| Working Time | Drilling | 51°40' | 47.4 % | 35.9 % |
| | Hoisting & Lowering Rod | 2°30' | 2.3 | 1.7 |
| | Hoisting & Lowering I. T. | 16°30' | 15.1 | 11.4 |
| | Miscellaneous | 20°50' | 19.1 | 14.5 |
| | Repairing | - | - | - |
| | Others | 17°30' | 16.1 | 12.2 |
| | TOTAL | 109°00' | 100 % | 75.7 % |
| | Re-moving: Preparation | 21°00' | | 14.6 |
| | Re-moving: Moving | 14°00' | | 9.7 |
| | G. TOTAL | 144°00' | | 100 % |

**Core Recovery for 100m Section**

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 97.0 % | 97.0 % | 400~500 | | |
| 100~200 | 100 | 98.0 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

**Efficiency of Drilling**

| | |
|---|---|
| 151.60 m /Work Period | 10.82 m/Day |
| 151.60 m /Working Days | 12.63 m/Day |
| 151.60 m /Drilling Period | 18.95 m/Day |
| 151.60 m /Net Drilling Days | 21.65 m/Day |
| | |
| Total Workers/ 151.60 m | 1.266 Shift |
| Total Drilling Workers/ 151.60 m | 0.738 Shift |
| Hoisting & Lowering Rod 1 Times | Hoisting & Lowering I. T. 68 Times |

Remarks

| Casing Pipe Inserted: Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|
| 112 m/m 3.00 m | 2.0 % | 100 % |
| NX 33.00 m | 21.8 | 100 |
| BX 90.60 m | 59.8 | 100 |
| | | |

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-15 DDH. JS-12

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 1st Feb. 1974 ~ 4th Feb. 1974 | 4 | 3 | 1 | 45 |
| | Drilling | 5th Feb. 1974 ~ 11th Feb. 1974 | 7 | 6 | 1 | 80 |
| | Removing | 12th Feb. 1974 ~ 13th Feb. 1974 | 2 | 1 | 1 | 13 |
| | TOTAL | 1st Feb. 1974 ~ 13th Feb. 1974 | 13 | 10 | 3 | 138 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 150.00 m | | | |
| | Increase or Decrease in Length | 1.00 m | Core Length | 139.70 m | |
| | Length Drilled | 151.00 m | Core Recovery | 92.5 % | |
| Working Time | Drilling | | 48°50' | 53.1 % | 40.7 % |
| | Hoisting & Lowering Rod | | 0°30' | 0.5 | 0.4 |
| | Hoisting & Lowering I. T. | | 15°10' | 16.5 | 12.7 |
| | Miscellaneous | | 13°00' | 14.1 | 10.8 |
| | Repairing | | - | - | - |
| | Others | | 14°30' | 15.8 | 12.1 |
| | TOTAL | | 92°00' | 100 % | 76.7 % |
| | Re-moving | Preparation | 21°00' | | 17.5 |
| | | Moving | 7°00' | | 5.8 |
| | G. TOTAL | | 120°00' | | 100 % |

**Core Recovery for 100m Section**

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 88.7 % | 88.7 % | 400~500 | | |
| 100~200 | 100 | 92.5 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~300 | | |

**Efficiency of Drilling**

| | |
|---|---|
| 151.00 m /Work Period | 11.61 m/Day |
| 151.00 m /Working Days | 15.10 m/Day |
| 151.00 m /Drilling Period | 21.57 m/Day |
| 151.00 m /Net Drilling Days | 25.16 m/Day |
| | |
| Total Workers/ 151.00 m | 0.913 Shift |
| Total Drilling Workers/ 151.00 m | 0.529 Shift |
| Hoisting & Lowering Rod 3 Times | Hoisting & Lowering I. T. 61 Times |

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 6.10 m | 4.0 % | 100 % |
| | NX 19.50 m | 12.9 | 100 |
| | BX | | |
| | | | |

Remarks

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-16 DDH. JK-1

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 31st Jan. 1974 ~ 4th Feb. 1974 | 5 | 4 | 1 | 56 |
| | Drilling | 5th Feb. 1974 ~ 20th Feb. 1974 | 16 | 13 | 3 | 172 |
| | Removing | 21st Feb. 1974 ~ 22nd Feb. 1974 | 2 | 2 | - | 28 |
| | TOTAL | 31st Jan. 1974 ~ 22nd Feb. 1974 | 23 | 19 | 4 | 256 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 200.00 m | | | |
| | Increase or Decrease in Length | 101.60 m | Core Length | 292.10 m | |
| | Length Drilled | 301 60 m | Core Recovery | 96.8 % | |
| Working Time | Drilling | | 100°40' | 50.9 % | 41.9 % |
| | Hoisting & Lowering Rod | | 4°50' | 2.4 | 2.0 |
| | Hoisting & Lowering I. T. | | 42°00' | 21.2 | 17.5 |
| | Miscellaneous | | 22°30' | 11.4 | 9.4 |
| | Repairing | | - | - | - |
| | Others | | 28°00' | 14.1 | 11.7 |
| | TOTAL | | 198°00' | 100 % | 82.5 % |
| | Re-moving | Preparation | 28°00' | | 11.7 |
| | | Moving | 14°00' | | 5.8 |
| | G. TOTAL | | 240°00' | | 100 % |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 97.0 % | 97.0 % | 400~500 | | |
| 100~200 | 100 | 98.5 | 500~600 | | |
| 200~300 | 95.1 | 96.8 | 600~700 | | |
| 300~400 | | | 700~800 | | |

Efficiency of Drilling

| | |
|---|---|
| 301.60 m /Work Period | 13.11 m/Day |
| 301.60 m /Working Days | 15.87 m/Day |
| 301.60 m /Drilling Period | 18.85 m/Day |
| 301.60 m /Net Drilling Days | 23.20 m/Day |
| | |
| Total Workers/301.60 m | 0.848 Shift |
| Total Drilling Workers/301.60 m | 0.570 Shift |
| Hoisting & Lowering Rod 3 Times | Hoisting & Lowering I. T. 150 Times |

Casing Pipe Inserted

| Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|
| 112 m/m 3.00 m | 1.0 % | 100 % |
| NX 36.00 m | 12.0 | 50 |
| BX 201.60 m | 66.7 | 100 |
| | | |

Remarks

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-17 DDH. JK-2

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 23rd Feb. 1974 ~ 25th Feb. 1974 | 2.5 | 2.5 | - | 37 |
| | Drilling | 25th Feb. 1974 ~7th Mar. 1974 | 10.5 | 9.5 | 1 | 131 |
| | Removing | 8th Mar. 1974 | 1 | 1 | - | 14 |
| | TOTAL | 23rd Feb. 1974 ~8th Mar. 1974 | 14 | 13 | 1 | 182 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | | 200.00 m | | |
| | Increase or Decrease in Length | | 101.10 m | Core Length | 296.90 m |
| | Length Drilled | | 301.10 m | Core Recovery | 98.6 % |
| Working Time | Drilling | | 83°30' | 53.7 % | 45.4 % |
| | Hoisting & Lowering Rod | | 1°40' | 1.0 | 0.9 |
| | Hoisting & Lowering I. T. | | 32°30' | 20.9 | 17.7 |
| | Miscellaneous | | 21°50' | 14.1 | 11.8 |
| | Repairing | | - | - | - |
| | Others | | 16°00' | 10.3 | 8.7 |
| | TOTAL | | 155°30' | 100 % | 84.5 % |
| | Re-moving | Preparation | 21°00' | | 11.4 |
| | | Moving | 7°30' | | 4.1 |
| | G. TOTAL | | 184°00' | | 100 % |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 97.0 % | 97.0 % | 400~500 | | |
| 100~200 | 100 | 98.5 | 500~600 | | |
| 200~300 | 98.8 | 98.6 | 600~700 | | |
| 300~400 | | | 700~800 | | |

Efficiency of Drilling

| | |
|---|---|
| 301.10 m /Work Period | 21.50 m/Day |
| 301.10 m /Working Days | 23.16 m/Day |
| 301.10 m /Drilling Period | 28.67 m/Day |
| 301.10 m /Net Drilling Days | 31.69 m/Day |
| | |
| Total Workers/ 301.10 m | 0.604 Shift |
| Total Drilling Workers/ 301.10 m | 0.435 Shift |

| Hoisting & Lowering Rod | Hoisting & Lowering I. T. |
|---|---|
| 2 Times | 138 Times |

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 3.00 m | 1.0 % | 100 % |
| | NX 25.50 m | 8.5 | 56.9 |
| | BX | | |
| | | | |

Remarks

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-18 DDH. JK-3

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 9th Mar. 1974 ~ 12th Mar. 1974 | 4 | 3 | 1 | 42 |
| | Drilling | 13th Mar. 1974 ~ 23rd Mar. 1974 | 11 | 11 | - | 154 |
| | Removing | 24th Mar. 1974 ~ 30th Mar. 1974 | 7 | 6 | 1 | 69 |
| | TOTAL | 9th Mar. 1974 ~30th Mar. 1974 | 22 | 20 | 2 | 265 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 200.00 m | | | |
| | Increase or Decrease in Length | 101.60 m | Core Length | 288.00 m | |
| | Length Drilled | 301.60 m | Core Recovery | 95.5% | |

| Core Recovery for 100m Section | | | | | |
|---|---|---|---|---|---|
| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
| 0~100 | 87.7% | 87.7% | 400~500 | | |
| 100~200 | 99.8 | 93.8 | 500~600 | | |
| 200~300 | 99.0 | 95.5 | 600~700 | | |
| 300~400 | | | 700~800 | | |

| | | | | | |
|---|---|---|---|---|---|
| Working Time | Drilling | 86°20' | 46.4% | 33.7% |
| | Hoisting & Lowering Rod | 5°00' | 2.7 | 2.0 |
| | Hoisting & Lowering I. T. | 39°00' | 21.0 | 15.2 |
| | Miscellaneous | 32°10' | 17.3 | 12.6 |
| | Repairing | - | - | - |
| | Others | 23°30' | 12.6 | 9.2 |
| | TOTAL | 186°00' | 100 % | 72.7% |
| | Re-moving: Preparation | 21°00' | | 8.2 |
| | Re-moving: Moving | 49°00' | | 19.1 |
| | G. TOTAL | 256°00' | | 100 % |

| Efficiency of Drilling | |
|---|---|
| 301.60 m /Work Period | 13.70 m/Day |
| 301.60 m /Working Days | 15.08 m/Day |
| 301.60 m /Drilling Period | 27.42 m/Day |
| 301.60 m /Net Drilling Days | 27.42 m/Day |
| | |
| Total Workers/301.60 m | 0.878 Shift |
| Total Drilling Workers/ 301.60 m | 0.510 Shift |
| Hoisting & Lowering Rod 5 Times | Hoisting & Lowering I. T. 164 Times |

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 1.60 m | 0.5 % | 100 % |
| | NX 63.00 m | 20.8 | 52.4 |
| | BX 142.50 m | 47.2 | 100 |
| | | | |

Remarks

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-19 DDH. IP-1

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 14th Feb. 1974 ~ 17th Feb. 1974 | 4 | 3 | 1 | 39 |
| | Drilling | 18th Feb. 1974 ~ 24th Feb. 1974 | 7 | 7 | - | 91 |
| | Removing | 25th Feb. 1974 | 1 | 1 | - | 13 |
| | TOTAL | 14th Feb. 1974 ~ 25th Feb. 1974 | 12 | 11 | 1 | 143 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 200.00 m | | | |
| | Increase or Decrease in Length | 1.20 m | Core Length | 195.80 m | |
| | Length Drilled | 201.20 m | Core Recovery | 97.3 % | |
| Working Time | Drilling | 59°00' | 54.6 % | 43.4 % | |
| | Hoisting & Lowering Rod | 2°40' | 2.5 | 1.9 | |
| | Hoisting & Lowering I. T. | 22°30' | 20.8 | 16.5 | |
| | Miscellaneous | 9°20' | 8.7 | 6.9 | |
| | Repairing | - | - | - | |
| | Others | 14°30' | 13.4 | 10.7 | |
| | TOTAL | 108°00' | 100 % | 79.4 % | |
| | Re-moving | Preparation | 21°00' | | 15.5 |
| | | Moving | 7°00' | | 5.1 |
| | G. TOTAL | 136°00' | | 100 % | |

**Core Recovery for 100m Section**

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 94.6 % | 94.6 % | 400~500 | | |
| 100~200 | 100 | 97.3 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

**Efficiency of Drilling**

| | |
|---|---|
| 201.20 m /Work Period | 16.76 m/Day |
| 201.20 m /Working Days | 18.29 m/Day |
| 201.20 m /Drilling Period | 28.74 m/Day |
| 201.20 m /Net Drilling Days | 28.74 m/Day |
| | |
| Total Workers/ 201.20 m | 0.710 Shift |
| Total Drilling Workers/ 201.20 m | 0.452 Shift |
| Hoisting & Lowering Rod 11 Times | Hoisting & Lowering I. T. 93 Times |

Remarks

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 3.60 m | 1.8 % | 100 % |
| | NX 18.10 m | 9.0 | 100 |
| | BX | | |
| | | | |

Table 3-20 DDH. IP-2

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 26th Feb. 1974 ~ 27th Feb. 1974 | 2 | 2 | - | 26 |
| | Drilling | 28th Feb. 1974 ~ 7th Mar. 1974 | 7.5 | 6.5 | 1 | 85 |
| | Removing | 7th Mar. 1974 ~ 8th Mar. 1974 | 1.5 | 1.5 | - | 19 |
| | TOTAL | 26th Feb. 1974 ~ 8th Mar. 1974 | 11 | 10 | 1 | 130 |

| | | | | | |
|---|---|---|---|---|---|
| Drilling Length | Planned Length | 200.00 m | | | |
| | Increase or Decrease in Length | 1.00 m | Core Length | 195.20 m | |
| | Length Drilled | 201.00 m | Core Recovery | 97.1 % | |
| Working Time | Drilling | | 58°50' | 54.5 % | 43.2 % |
| | Hoisting & Lowering Rod | | 3°30' | 3.2 | 2.6 |
| | Hoisting & Lowering I. T. | | 18°10' | 16.8 | 13.4 |
| | Miscellaneous | | 13°30' | 12.5 | 9.9 |
| | Repairing | | - | - | - |
| | Others | | 14°00' | 13.0 | 10.3 |
| | TOTAL | | 108°00' | 100 % | 79.4 % |
| | Re-moving | Preparation | 14°00' | - | 10.3 |
| | | Moving | 14°00' | - | 10.3 |
| | G. TOTAL | | 136°00' | - | 100 % |

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 1.60 m | 0.8 % | 100 % |
| | NX 13.50 m | 6.7 | 100 |
| | BX 135.00 m | 67.2 | 100 |
| | | | |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 94.2 % | 94.2 % | 400~500 | | |
| 100~200 | 100 | 97.1 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

Efficiency of Drilling

| | |
|---|---|
| 201.00 m /Work Period | 18.27 m/Day |
| 201.00 m /Working Days | 20.10 m/Day |
| 201.00 m /Drilling Period | 26.80 m/Day |
| 201.00 /Net Drilling Days | 30.92 m/Day |
| | |
| Total Workers/ 201.00 m | 0.646 Shift |
| Total Drilling Workers/ 201.00 m | 0.422 Shift |

| | |
|---|---|
| Hoisting & Lowering Rod 11 Times | Hoisting & Lowering I. T. 76 Times |

Remarks

## SUMMARY RECORD OF DRILLING RESULTS

Table 3-21 DDH. IP-3

| | | Period | Number of Days | Actual Working Days | Day Off | Total Number of Working |
|---|---|---|---|---|---|---|
| Drilling Periods | Preparation | 9th Mar. 1974 ~ 12th Mar. 1974 | 4 | 3 | 1 | 39 |
| | Drilling | 13th Mar. 1974 ~ 20th Mar. 1974 | 8 | 8 | - | 104 |
| | Removing | 21st Mar. 1974 ~ 30th Mar. 1974 | 10 | 8 | 2 | 89 |
| | TOTAL | 9th Mar. 1974 ~ 30th Mar. 1974 | 22 | 19 | 3 | 232 |

| | | | | |
|---|---|---|---|---|
| Drilling Length | Planned Length | 200.00 m | | |
| | Increase or Decrease in Length | 0.60 m | Core Length | 153.40 m |
| | Length Drilled | 200.60 m | Core Recovery | 76.5 % |
| Working Time | Drilling | 56°00' | 40.3 % | 25.9 % |
| | Hoisting & Lowering Rod | 3°00' | 2.1 | 1.4 |
| | Hoisting & Lowering I. T. | 19°50' | 14.3 | 9.2 |
| | Miscellaneous | 22°10 | 15.9 | 10.3 |
| | Repairing | 19°00' | 13.7 | 8.8 |
| | Others | 19°00' | 13.7 | 8.8 |
| | TOTAL | 139°00' | 100 % | 64.4 % |
| | Re-moving: Preparation | 21°00' | | 9.7 |
| | Re-moving: Moving | 56°00' | | 25.9 |
| | G. TOTAL | 216°00' | | 100 % |

Core Recovery for 100m Section

| Depth of Hole | Section | Total | Depth of Hole | Section | Total |
|---|---|---|---|---|---|
| 0~100 | 58.8 % | 58.8 % | 400~500 | | |
| 100~200 | 94.6 | 76.5 | 500~600 | | |
| 200~300 | | | 600~700 | | |
| 300~400 | | | 700~800 | | |

Efficiency of Drilling

| | |
|---|---|
| 200.60 m /Work Period | 9.12 m/Day |
| 200.60 m /Working Days | 10.56 m/Day |
| 200.60 m /Drilling Period | 25.07 m/Day |
| 200.60 m /Net Drilling Days | 25.07 m/Day |
| | |
| Total Workers/ 200.60 m | 1.156 Shift |
| Total Drilling Workers/200.60 m | 0.518 Shift |

| Hoisting & Lowering Rod | Hoisting & Lowering I. T. |
|---|---|
| 12 Times | 76 Times |

Remarks

| | Pipe Size & Meterage | Inserted Length / Drilling Length (%) | Recovery of Casing Pipe |
|---|---|---|---|
| Casing Pipe Inserted | 112 m/m 1.60 m | 0.8 % | 100 % |
| | NX 37.00 m | 18.4 | 75.7 |
| | BX 147.50 m | 73.5 | 100 |
| | | | |

Table 3-22 Specifications Diamond Bits and Reaming Shells

| Item | Size | Type | Carat | Matrix | Size (diamond) | Water way | Quantity (pc.) | Remarks |
|---|---|---|---|---|---|---|---|---|
| Diamond Bit | 101 ‰ | D−10 | 180.00 cts | Z | 1/20 cts | 6 | 6 | Z = RC 30 |
| | NX | NQT.WL | 870.00 | Z | 1/20 | 6 | 29 | |
| | BX | BQT.WL | 620.00 | Z | 1/20 | 4 | 31 | |
| | Total | | 1,670.00 | | | | 66 | |
| | | | | | | | | |
| Reaming Shell | 101 ‰ | D−10 | 16.00 | Z | 1/15 ~ 1/20 | 6 | 2 | Z = RC 30 |
| | NX | NQT.WL | 66.40 | Z | 1/15 ~ 1/20 | 6 | 10 | |
| | BX | BQT.WL | 55.00 | Z | 1/15 ~ 1/20 | 4 | 12 | |
| | Total | | 137.40 | | | | 24 | |
| | | | | | | | | |
| | | | | | | | | |
| | Grand Total | | 1,807.40 | | | | 90 | |

RC = Rockwell C scale

Table 3-23(1) Drilling Meterage by Diamond Bit and Reaming Shell

| Item | Size | Type | Bit No. | Drilling Meterage by Borehole | | | | | | | | | | | | | | | | | | | Remarks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DDH JS-1 | DDH JS-2 | DDH JS-3 | DDH JS-4 | DDH JS-5 | DDH JS-6 | DDH JS-7 | DDH JS-8 | DDH JS-9 | DDH JS-10 | DDH JS-11 | DDH JS-12 | DDH JK-1 | DDH JK-2 | DDH JK-3 | DDH IP-1 | DDH IP-2 | DDH IP-3 | TOTAL | Resetting (JAPAN) | Unused (BURMA) | Usable (BURMA) |
| BIT | 101 ㎜ | D－10 | 6865 | | | | | | 1.40 | | 1.40 | | 1.40 | | 4.50 | 33.00 | 22.50 | 1.70 | 17.50 | 11.90 | 14.80 | 110.10 | ○ | | |
| | 〃 | 〃 | 6866 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 6867 | 1.10 | | 1.40 | | | | | | | | | | | | | | | | 2.50 | ○ | | |
| | 〃 | 〃 | 8693 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 8694 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 8692 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| BIT | NX | NQT.WL | 8701 | 90.10 | | | | | | | | | | | | 49.60 | | | | | | 139.70 | ○ | | |
| | 〃 | 〃 | 8702 | | | | | | | | | | | | | | 30.00 | 139.20 | | | | 169.20 | ○ | | |
| | 〃 | 〃 | 8703 | | | | 66.50 | | | | | | | | 144.90 | | | | | | | 211.40 | ○ | | |
| | 〃 | 〃 | 8700 | | | | | 86.50 | | | | | | | | | 82.80 | | | | 53.50 | 222.80 | ○ | | |
| | 〃 | 〃 | 6874 | | | | | | | | | | | | | 158.60 | | | | | | 158.60 | ○ | | |
| | 〃 | 〃 | 6875 | | | | | | | 96.20 | | | | | | | | | | 69.70 | | 165.90 | ○ | | |
| | 〃 | 〃 | 6870 | | | | 82.10 | | | | | | | | | | | | | | 93.40 | 175.50 | ○ | | |
| | 〃 | 〃 | 6869 | | | | | | | | 87.10 | | | | | | | | | | | 87.10 | ○ | | |
| | 〃 | 〃 | 6871 | | | | | | | | | | | 87.60 | | | | | | | | 87.60 | ○ | | |
| | 〃 | 〃 | 6872 | | | | | | | | | | | | | | 185.30 | | | | | 185.30 | ○ | | |
| | 〃 | 〃 | 6873 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 8698 | | | 63.30 | | | | | | | | | | | | | | | | 63.30 | ○ | | |
| | 〃 | 〃 | 6868 | 56.20 | | | | | | | | | | | | | | | 86.70 | 52.80 | | 195.70 | ○ | | |
| | 〃 | 〃 | 6876 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 6877 | | | | | | | | | | 88.50 | | | | | | | | | 88.50 | ○ | | |
| | 〃 | 〃 | 8699 | | | 84.40 | | | | | | | | | | | | | | | | 84.40 | ○ | | |
| | 〃 | 〃 | 8697 | | 48.00 | | | | | | | | | | | | | | 95.40 | | | 143.40 | ○ | | |
| | 〃 | 〃 | 8696 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 8705 | | | | | | | | | 81.10 | | | | | | | | | | 81.10 | ○ | | |
| | 〃 | 〃 | 8704 | | | | | 62.90 | 81.90 | | | | | | | | | | | | | 144.80 | ○ | | |
| | 〃 | 〃 | 5666 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5667 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5668 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 4755 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 4756 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 4757 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 4758 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 4759 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 4760 | | | | | | | | | | | | | | | | | | | | | ○ | |

Table 3-23(2)

| Item | Size | Type | Bit No. | Drilling Meterage by Borehole | | | | | | | | | | | | | | | | | | | Remarks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DDH JS-1 | DDH JS-2 | DDH JS-3 | DDH JS-4 | DDH JS-5 | DDH JS-6 | DDH JS-7 | DDH JS-8 | DDH JS-9 | DDH JS-10 | DDH JS-11 | DDH JS-12 | DDH JK-1 | DDH JK-2 | DDH JK-3 | DDH IP-1 | DDH IP-2 | DDH IP-3 | TOTAL | Resetting (JAPAN) | Unused (BURMA) | Usable (BURMA) |
| BIT | BX | BQT.WL | 221 | | | | | | 65.50 | | | | | | | 100.40 | | | | | | 165.90 | ○ | | |
| | 〃 | 〃 | 222 | | | | | | | | | | | | | | | 73.40 | | | | 73.40 | ○ | | |
| | 〃 | 〃 | 223 | | | | | | | | | | | 61.00 | | | | | | 65.00 | 40.80 | 166.80 | ○ | | |
| | 〃 | 〃 | 224 | | | | | | | | | | 59.50 | | | | | | | | | 59.50 | ○ | | |
| | 〃 | 〃 | 321 | | | | | | | 51.80 | | | | | | | | | | | | 51.80 | ○ | | |
| | 〃 | 〃 | TB-15 | | | | | | | | | | | | | | | 49.20 | | | | 49.20 | ○ | | |
| | 〃 | 〃 | 8710 | | | | | | | | 60.90 | | | | | | | | | | | 60.90 | ○ | | |
| | 〃 | 〃 | 8711 | | | | | | | | | | | | | | | 36.50 | | | | 36.50 | ○ | | |
| | 〃 | 〃 | 8712 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 8713 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 8714 | | 100.10 | | | | | | | | | | | | | | | | | 100.10 | ○ | | |
| | 〃 | 〃 | 8715 | | | | | | | | | 67.40 | | | | | | | | | | 67.40 | ○ | | |
| | 〃 | 〃 | 5702 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5703 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5704 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5705 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5706 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5707 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5671 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5672 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5673 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5674 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5675 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5676 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5677 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5678 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5679 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5680 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5681 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5682 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5683 | | | | | | | | | | | | | | | | | | | | | ○ | ○ |
| | TOTAL | | 66 | 147.40 | 148.10 | 149.10 | 148.60 | 149.40 | 148.80 | 148.00 | 149.40 | 148.50 | 149.40 | 148.60 | 149.40 | 341.60 | 320.60 | 300.00 | 199.60 | 199.40 | 202.50 | 3,348.40 | 29 | 37 | |
| TRI-CONE BIT | 112% | | 2 | 3.00 | 3.00 | 1.60 | 3.00 | 1.60 | 1.60 | 3.00 | 1.60 | 3.00 | 1.60 | 3.00 | 1.60 | 3.00 | 3.00 | 1.60 | 1.60 | 1.60 | 1.60 | 40.00 | | | 0 |
| BIT | GRAND TOTAL | | 68 | 150.40 | 151.10 | 150.70 | 151.60 | 151.00 | 150.40 | 151.00 | 151.00 | 151.50 | 151.00 | 151.60 | 151.00 | 344.60 | 323.60 | 301.60 | 201.20 | 201.00 | 204.10 | 3,388.40 | 29 | 37 | 2 |

Table 3-23(3)

| Item | Size | Type | Bit No. | Drilling Meterage by Borehole | | | | | | | | | | | | | | | | | | | Remarks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DDH JS-1 | DDH JS-2 | DDH JS-3 | DDH JS-4 | DDH JS-5 | DDH JS-6 | DDH JS-7 | DDH JS-8 | DDH JS-9 | DDH JS-10 | DDH JS-11 | DDH JS-12 | DDH JK-1 | DDH JK-2 | DDH JK-3 | DDH IP-1 | DDH IP-2 | DDH IP-3 | TOTAL | Resetting (JAPAN) | Unused (BURMA) | Usable (BURMA) |
| REAMING SHELL | 101% | D－10 | 2940 | 1.10 | | 1.40 | | | 1.40 | | 1.40 | | 1.40 | | 4.50 | 33.00 | 22.50 | 1.70 | 17.50 | 11.90 | 14.80 | 112.60 | ○ | | |
| | 〃 | 〃 | 8695 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| | NX | NQT.WL | 4 | | | | | | | | | | 88.50 | | 144.90 | | | | | | | 233.40 | ○ | | |
| | 〃 | 〃 | 2941 | | | | | | | 96.20 | | | | | | 158.60 | | | | | 53.50 | 308.30 | ○ | | |
| | 〃 | 〃 | 2942 | | | | | | | | | | | | | | 298.10 | | | | | 298.10 | ○ | | |
| | 〃 | 〃 | 2367 | | 48.00 | 147.70 | | | | | | | | | | | | 139.20 | | | | 334.90 | ○ | | |
| | 〃 | 〃 | 8706 | | | | | | | | | 81.10 | | 87.60 | | 49.60 | | | 182.10 | | | 400.40 | ○ | | |
| | 〃 | 〃 | 8707 | 146.30 | | | | | | | 87.10 | | | | | | | | | 51.80 | | 285.20 | ○ | | |
| | 〃 | 〃 | 8708 | | | | 148.60 | | | | | | | | | | | | | | 93.40 | 242.00 | ○ | | |
| | 〃 | 〃 | 8709 | | | | | 149.40 | 81.90 | | | | | | | | | | | 69.70 | | 301.00 | ○ | | |
| | 〃 | 〃 | 5669 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5670 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| REAMING SHELL | BX | BQT-WL | 5－1 | | | | | | | 51.80 | | 67.40 | | | | | | | | 66.00 | | 185.20 | ○ | | |
| | 〃 | 〃 | 2429 | | | | | | | | | | | 61.00 | | 100.40 | | | | | | 161.40 | ○ | | |
| | 〃 | 〃 | 8428 | | | | | | | | | | | | | | | | | | 40.80 | 40.80 | ○ | | |
| | 〃 | 〃 | 8717 | | | | | | | | | | 59.50 | | | | | 159.10 | | | | 218.60 | ○ | | |
| | 〃 | 〃 | 8718 | | 100.10 | | | | 65.50 | | 60.90 | | | | | | | | | | | 226.50 | ○ | | |
| | 〃 | 〃 | 8716 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5688 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5689 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5684 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5685 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5686 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | 〃 | 〃 | 5687 | | | | | | | | | | | | | | | | | | | | | ○ | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| REAMING SHELL | TOTAL | | 24 | 147.40 | 148.10 | 149.10 | 148.60 | 149.40 | 148.80 | 148.00 | 149.40 | 148.50 | 149.40 | 148.60 | 149.40 | 341.60 | 320.60 | 300.00 | 199.60 | 199.40 | 202.50 | 3,348.40 | 14 | 10 | |

# PART IV METALLURGICAL TESTS

## Part IV Metallurgical Tests

## List of Figures



## List of Tables

## Part IV Metallurgical Tests

### Chapter 1 Metallurgical Tests

#### 1-1 Purpose of the Tests

The metallurgical tests were carried out for the purpose to obtain the proper informations of the properties of the Sabedaung ore from the stand points of the mineral processing as well as to serve for the designing of the pilot plant.

The materials required for the tests were obtained from the cores of nine drill holes done on the Sabedaung ore deposit during this year phase, which were thought to represent the very natures of the deposits. The test works were performed in Japan.

#### 1-2 Ore Samples Tested

##### 1-2-1 Locations of Ore Samples

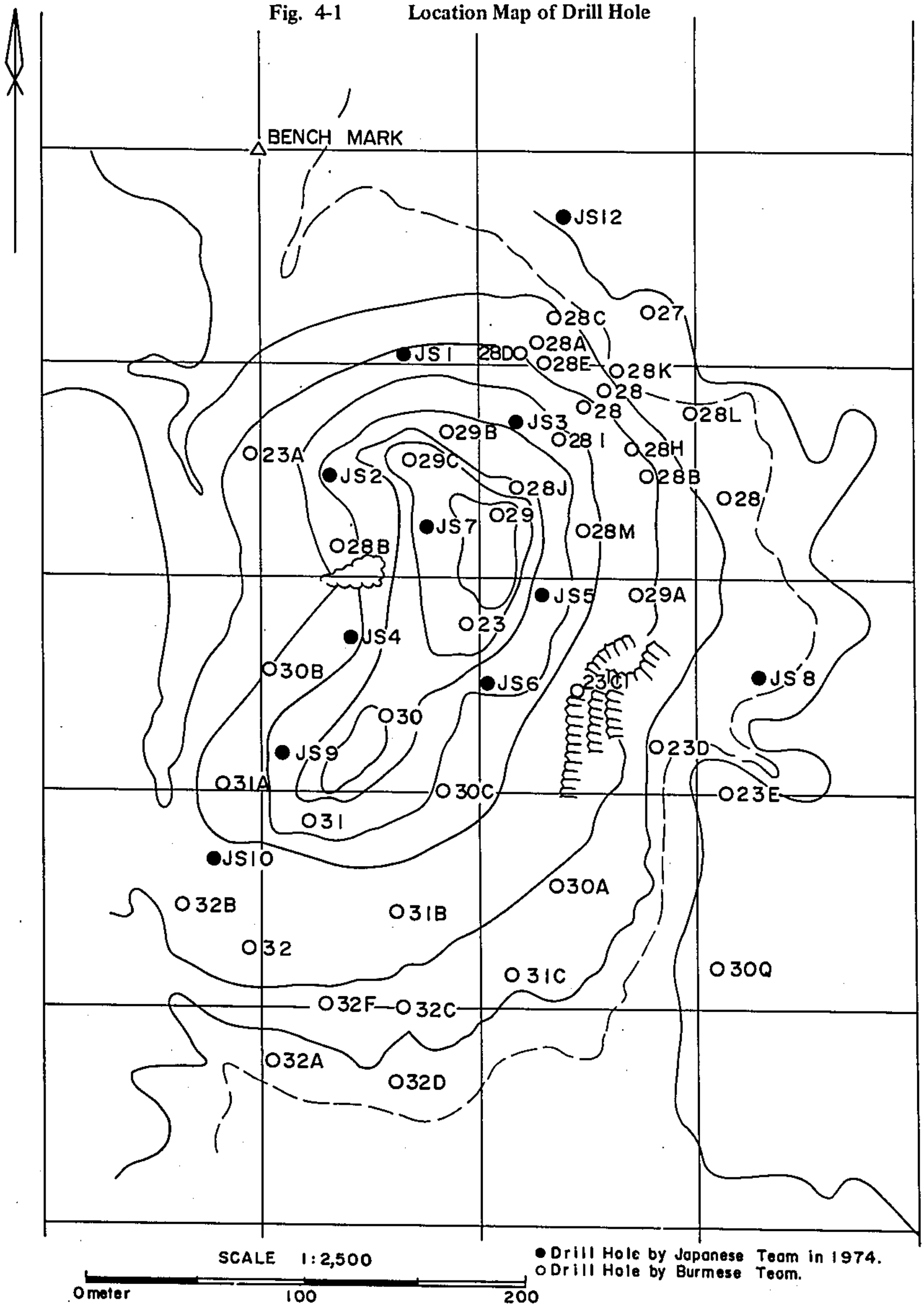
The locations of the drill holes from which the ore samples were collected are shown in Fig. 4-1.

They were taken from the nine drill holes among the twelve, done on the Sabedaung ore deposits, and the cores were split into two, one half of which, weighing about two metric tons, were bagged at every 3 meters in depths.

They were transported by the railway from Monywa to Rangoon, and by air from Rangoon to Japan.

As soon as the samples arrived on February 26, 1974, the

Fig. 4-1 Location Map of Drill Hole



metallurgical tests were commenced.

As shown on Table 4-1, the core samples were classified into the upper ore, lower ore, and low grade ore according to their depths taken, and the upper and lower ores were subjected for the tests of which classification is given on the following Table 4-1.

1-2-2 Assays of Ore Samples

The chemical analysis of the main components of the ore samples tested are given on Table 4-2. Except for the upper ore showing slightly higher content of acid soluble copper than the lower ore, there has not been found any remarkable difference between the two kinds of ores in the contents of other components. Copper shows about 0.9 % and gold and silver are so low as below 0.1 g/t Au and below 1 g/t Ag. The results of the quantitative spectrophotometry have revealed the other components except copper are generally too minor in amount to be objectives to recover.

1-3 Properties of Ore

1-3-1 Work Index and Specific Gravity

The grinding work indices and specific gravities were measured as shown on Table 4-3.

The work index of the upper ore was 12.1 kwh/short ton and 11.1 kwh/short ton in the lower ore, both showing the average hardness of ore in general, but the upper ore was found a little harder to be ground than the lower ore.

Table 4-1 Classification of the Core Samples

| Hole No. | Ore of Upper Zone | Ore of Lower Zone | Low Grade Ore |
|---|---|---|---|
| | Depth (m) | | |
| JS-1 | 18.0 ~ 70.0 | 70.0 ~ 92.0 | 92.0 ~ 114.0 |
| JS-2 | 24.5 ~ 62.5 | 62.5 ~ 88.5 | 88.5 ~ 132.5 |
| JS-3 | 32.5 ~ 72.5 | 72.5 ~ 104.5 | 104.5 ~ 119.5 |
| JS-4 | 29.5 ~ 63.5 | 63.5 ~ 77.5 | 77.5 ~ 122.5 |
| JS-5 | 19.0 ~ 53.5 | 53.5 ~ 105.0 | 105.0 ~ 145.0 |
| JS-6 | 18.5 ~ 50.5 | 50.5 ~ 84.5 | 84.5 ~ 129.5 |
| JS-7 | 25.0 ~ 79.5 | 79.5 ~ 119.0 | 119.0 ~ 151.0 |
| JS-8 | 18.0 ~ 46.0 | 46.0 ~ 92.0 | 92.0 ~ 122.0 |
| JS-9 | 19.0 ~ 59.0 | 59.0 ~ 97.0 | 97.0 ~ 151.5 |
| Total wt. (kg) | 712.1 | 593.2 | 600.0 |

Table 4-2 Chemical Assay of the Ore Tested

| Ore | Assay (%) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cu | | S | Fe | As | $Al_2O_3$ | $SiO_2$ | Au (g/t) | Ag (g/t) | Hg (ppm) |
| | Total | Acid Sol. * | | | | | | | | |
| Upper Zone | 0.92 | 0.16 | 5.0 | 5.4 | 0.004 | 15.1 | 61.5 | <0.1 | <1 | <0.2 |
| Lower Zone | 0.94 | 0.10 | 5.6 | 5.6 | 0.005 | 14.6 | 62.8 | <0.1 | <1 | <0.2 |

* Acid soluble copper ; 2 grams of ore samples are treated in 50ml. of 5% solution of $H_2SO_4$ at the temperature of 80°C, kept in a water bath for 20 minutes. Thus, Cu content in the filtered solution is analysed quantitatively.

All other assays are based upon the Japanese Industrial Standard (JIS).

Table 4-3 Work Index and Specific Gravity of Ore

| Ore | Wi (Kwh/short t) * | S. G. ** |
|---|---|---|
| Upper Zone | 12.1 | 2.9 |
| Lower Zone | 11.1 | 2.9 |

* Measured by the Hardgrove Method.

** Measured by means of Pycnometer.

1-3-2 Soluble Ions

A sample of 250 grms. of ore, ground in dry under 100 mesh, was added by 250 ml. of pure water and kept stirring for two hours in beaker. The chemical analysis of the soluble ions extracted into the solution during this experiment are shown on Table 4-4, the upper ore showing a higher concentration of soluble ions than the lower ore.

1-3-3 Mineral Composition

The mineral composition has been summarized as follows after the microscopic observations and examinations by X-ray diffraction:

| | | | |
|---|---|---|---|
| Sulphide minerals, | as principal mineral: | | pyrite |
| | in small amount | : | chalcocite |
| | in minor amount | : | chalcopyrite |
| Gangue minerals, | quarts and minor amounts of calcite, | | |
| Clay minerals, | kaoline and sericite. | | |

Most of chalcocite are replacing the peripheries of pyrite after corrosion as well as showing various occurrences as minute veinlets in the crystal of pyrite, in dissemination, and concentrated in the middle of the comb-structure by the arrangement of pyrite.

The diameters of the chalcocite grains vary from one micron to 150 microns, but mostly come within the range of 10~40 microns. Such occurrences of copper minerals suggest the necessity of fine grinding of ore under 400 mesh for the recovery of copper concentrate.

1-4 Flotation Tests

1-4-1 Testing Apparatus

The flotation cells and ball mill were employed for the tests as shown on Table 4-5.

1-4-2 Water

Underground water (from Mitaka City, Tokyo) was used for flotation, of which chemical compositions is given on Table 4-6.

For the reference, the chemical composition of water of the Yama, Stream, Monywa, is given on Table 4-7.

1-4-3 Testing Procedures

Both the upper and lower ores were tested in the similar procedures, because the reconaissance tests had revealed practically no essential difference in the properties in regards to flotation between the said two kinds of ores.

The each feed of batch tests was sample of 500 grms ground by a ball mill in wet (55 % solid in pulp density), provisionally crushed in dry under 28 mesh. Roughing was proceeded by transferring the ground sample into the FW type flotation cell (25 % solid in pulp density).

The roughing froth was cleaned once more, and then reground by ball mill. The final copper concentrate was obtained after the fourth cleaning.

500 grms. flotation cell of FW type was used for the primary and secondary cleanings, and 150 grms. flotation cell of MS type for the third to the fifth cleanings.

Table 4-4 Water Soluble Ions

| Ore | Ion Concentration (ppm) | | | | PH |
|---|---|---|---|---|---|
| | Cu | Fe | As | $SO_4$ | |
| Upper Zone | 6.5 | 7.4 | <0.02 | 18,600 | 6.6 |
| Lower Zone | 0.43 | 0.18 | <0.02 | 3,800 | 7.2 |

Table 4-5 Laboratory Flotation Cell and Ball Mill

| Machine | Type | Capacity or Size | Use |
|---|---|---|---|
| Flotation Cell | FW | 500 g | Roughing and Cleaning |
| Flotation Cell | MS | 150 g | Cleaning |
| Ball Mill | Cylindrical | 150mmφ x 175mm<br>98 rpm<br>Ball Charge 3.3kg | |

Table 4-6 Chemical Composition of Underground Water taken from Mitaka, Tokyo

| Concentration (ppm) | | | | | | | PH |
|---|---|---|---|---|---|---|---|
| Total Dissolved Solids | Ca | Mg | Zn | Cu | Fe | Mn | |
| 366 | 33.8 | 25.0 | 0.09 | 0.07 | 0.70 | 0.04 | 7.0 |

Table 4-7 Chemical Composition of Yama Stream Water

| Date Sampled | Concentration (ppm) | | | | | | | | | | | | PH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Dissolved Solid | Cl | Ca | Mg | Fe | Cu | Zn | Na | $CO_3$ | $SO_4$ | As | Al | |
| May 27, '74* (Dry season) | 80 | 14 | 145 | | 1 | <0.01 | <0.01 | 60 | 8,540 | 28 | 0.01 | | 7.7 |
| Aug. to Sep., '73** (Rainy season) | 3,692 | 6.4 | 18.1 | 10.8 | 165 | | | | 128.7 | 20.6 | | 87.9 | 7.4 |

* By Hashizumi

** By D. G. S. E.

Cyanide as depressor of pyrite has never been used upon the request from the Burmese concern.

1-4-4 Grain Size of Feed of Roughing

A series of comparative tests by changing the grain sizes of the feeds were done, of which results are shown on Table 4-8. The highest recoveries of copper was obtained in those cases of 81.9 % of under 200 mesh grains in the upper ore and 69.7 % of under 200 mesh grains in the lower ore. The finer grain sizes below them rather lowered the recovery. Therefore, the tests thereafter were done in the states of 80 % of under 200 mesh in the upper ore and 70 % of under 200 mesh in the lower ore, of which results of screen analysis are shown on Table 4-9.

1-4-5 Conditioning Reagents

Lime was found most appropriate conditioning reagent after the various tests on the different materials.

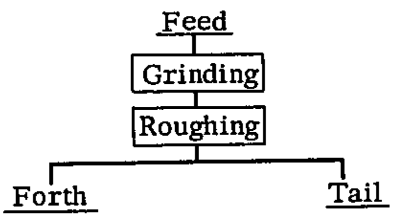
1-4-6 Roughing Time

The Table 4-10 shows the results of investigation about the relation between the roughing time and flotation results. As is clear from this, either of the upper or lower ore gave the recoveries of copper approximately 93 % after the duration of the flotation process for 15 minutes, but additional duration of flotation for about 5 to 10 minutes showed as small increase of recovery as only about one percent, because only the low grade froth were collected. Therefore,it can be concluded that the appropriate time for roughing is 15 minutes.

Table 4-8 Relation of Grinding Size to Result of Flotation

| Test No. | Size (Wt. %) | | | Rougher Froth | | |
|---|---|---|---|---|---|---|
| | +100 mesh | -200 mesh | -325 mesh | Wt. (%) | Assay (Cu %) | Recovery (Cu %) |
| Ore of Upper Zone | | | | | | |
| 14 | 7.5 | 65.2 | 51.1 | 12.3 | 4.76 | 61.5 |
| 5 | 1.1 | 81.9 | 63.4 | 14.4 | 5.08 | 80.9 |
| 4 | - | 91.1 | 72.5 | 14.7 | 4.90 | 79.3 |
| 6 | - | 95.1 | 79.7 | 14.1 | 4.94 | 77.5 |
| 7 | - | 97.7 | 87.1 | 14.7 | 4.86 | 78.2 |
| Ore of Lower Zone | | | | | | |
| 15 | 5.0 | 69.7 | 54.9 | 17.1 | 4.60 | 87.2 |
| 16 | 1.1 | 82.9 | 64.4 | 17.0 | 4.44 | 86.1 |
| 17 | - | 92.0 | 73.9 | 17.2 | 4.32 | 84.7 |

Common Condition




Pulp Density : 25% solid
Reagents : Collector 85 g/t
Frother 65 g/t
Roughing Time: 20 min.
PH : Upper Zone 6.4
Lower Zone 6.8

Table 4-9 Screen Analysis of Rougher Feed

| Mesh | Ore of Upper Zone (Test No. 5) | | | Ore of Lower Zone (Test No. 15) | | |
|---|---|---|---|---|---|---|
| | Wt. (%) | Grade (Cu %) | Distrib. (Cu %) | Wt. (%) | Grade (Cu %) | Distrib. (Cu %) |
| +65 | - | - | - | 0.9 | 0.29 | 0.3 |
| 65/100 | 1.1 | 0.40 | 0.4 | 4.1 | 0.39 | 1.7 |
| 100/150 | 6.5 | 0.65 | 4.5 | 13.0 | 0.67 | 9.4 |
| 150/200 | 10.5 | 0.81 | 9.0 | 12.3 | 1.02 | 13.6 |
| 200/325 | 18.5 | 0.97 | 19.0 | 14.8 | 1.09 | 17.4 |
| -325 | 63.4 | 1.00 | 67.1 | 54.9 | 0.97 | 57.6 |
| Total | 100.0 | 0.95 | 100.0 | 100.0 | 0.93 | 100.0 |

Distrib. = Distribution

Table 4-10 Relation between Metallurgical Results and Roughing Time

| Test No. | Products | Wt. | | Grade | | Recovery | | Common Condition |
|---|---|---|---|---|---|---|---|---|
| | | % | Σ | Cu % | Σ | Cu % | Σ | |
| | Ore of Upper Zone | | | | | | | Feed Size: Upper - 200m. 82% Lower - 200m. 70% |
| 39 | Feed | 100.0 | | 0.89 | | 100.0 | | |
| | Froth (0～2 min.) | 11.7 | | 5.50 | | 72.3 | | |
| | do. (2～4 min.) | 3.5 | 15.2 | 4.05 | 5.17 | 15.9 | 88.2 | |
| | do. (4～6 min.) | 1.8 | 17.0 | 1.44 | 4.77 | 2.9 | 91.1 | Pulp Density: 25% solid |
| | do. (6～10 min.) | 2.8 | 19.8 | 0.53 | 4.17 | 1.6 | 92.7 | |
| | do. (10～15 min.) | 4.8 | 24.6 | 0.20 | 3.40 | 1.1 | 93.8 | |
| | do. (15～20min.) | 3.0 | 27.6 | 0.26 | 3.06 | 0.9 | 94.7 | Reagents: |
| | do. (20～25min.) | 2.9 | 30.5 | 0.18 | 2.78 | 0.6 | 95.3 | Lime 2,000 g/t |
| | Tailing | 69.5 | | 0.06 | | 4.7 | | Collector 130 g/t |
| | Ore of Lower Zone | | | | | | | Frother 55 g/t |
| 40 | Feed | 100.0 | | 0.88 | | 100.0 | | PH: Upper 11.1 |
| | Froth (0～2 min.) | 15.7 | | 4.65 | | 83 2 | | Lower 11.9 |
| | do. (2～4 min.) | 2.2 | 17.9 | 2.70 | 4.41 | 6.8 | 90.0 | |
| | do. (4～6 min.) | 1.8 | 19.7 | 0.78 | 4.08 | 1.6 | 91.6 | |
| | do. (6～10min.) | 1.7 | 21.4 | 0.45 | 3.79 | 0.9 | 92.5 | |
| | do. (10～15min.) | 2.9 | 24.3 | 0.26 | 3.37 | 0.8 | 93.3 | |
| | do. (15～20min.) | 2.5 | 26.8 | 0.22 | 3.08 | 0.6 | 93.9 | |
| | do. (20～25min.) | 2.1 | 28.9 | 0.15 | 2.86 | 0.4 | 94.3 | |
| | Tailing | 71.1 | | 0.07 | | 5.7 | | |

1-4-7 Regrinding

As is stated in the microscopic observation, under 400 mesh is most adequate.

1-4-8 Locked Tests

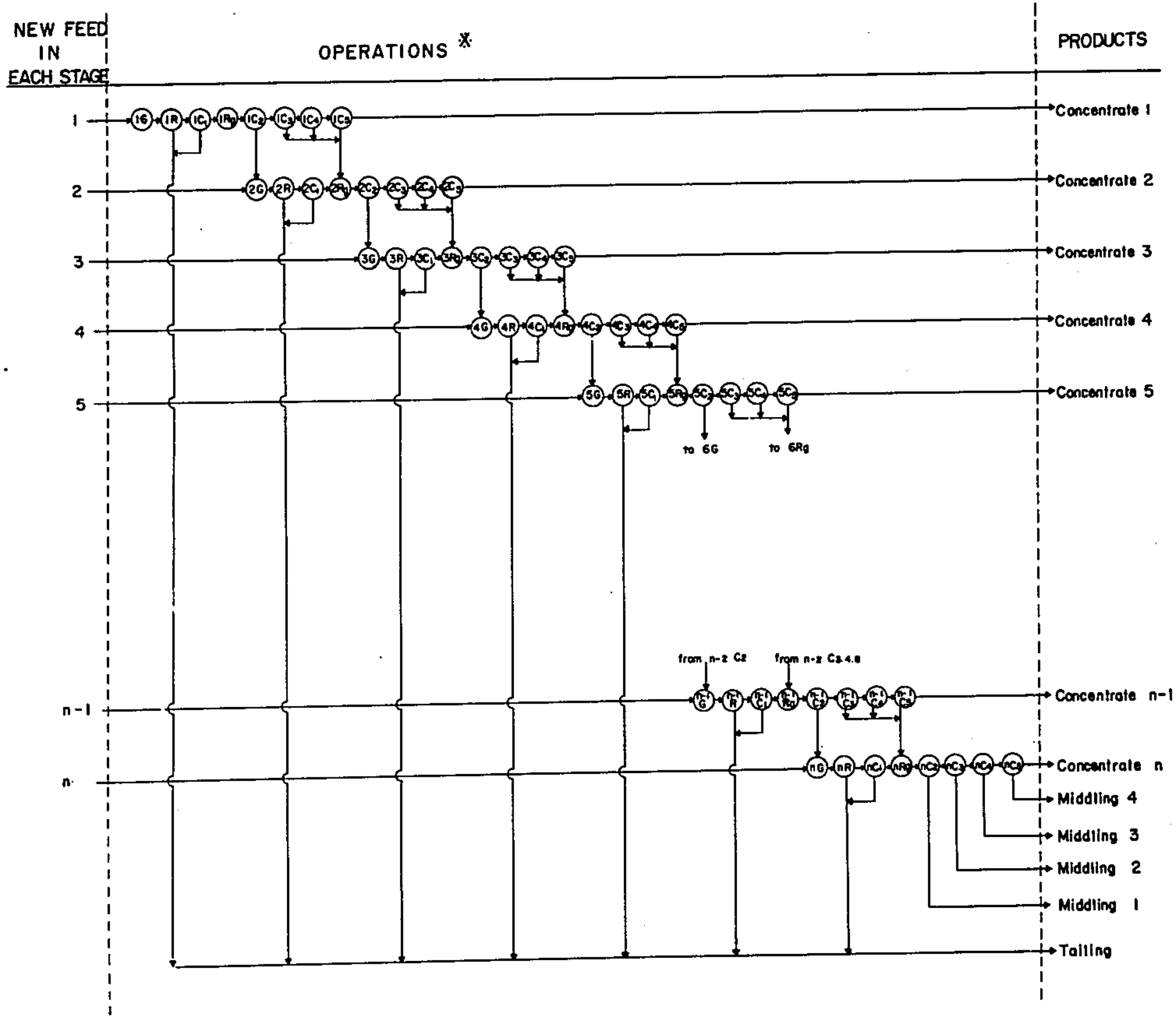
In order to pursue the effects of recycling of the cleaner tailings, the locked tests were done according to the flow sheets given in Fig. 4-2 and Fig. 4-3.

In this testing procedure on one new feed, the cleaner tailings obtained at every step of the cleaning were fed to the proper sections of the similar circuit of the next sample to be tested, from where the corresponding middling would be obtained respectively. In the tests of every new feed, such additional feedings were continued until the amount of concentrate produced became nearly constant. And then the recycling procedures were tried for 5 times and the averaged results from the later 3 new feeds were taken to represent the overall results of this locked test as shown on Table 4-11. It shows that from the upper ore the concentrate of 19.37 % Cu is obtained with 78.3 % of recovery and concentrate of 20.85 % Cu with the recovery of 80.2 % from the lower ore, the latter showing a little better results than the former.

1-5 Chemical Analysis of Concentrate

The chemical analysis of the concentrates obtained through the batch tests are shown on Table 4-12. As is clear, there is none of rejectable component for smelting among various components analysed.

Fig. 4-2 Flowsheet of Locked Test

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LEGEND

G = Grinding

R = Roughing

C1 = 1 st Cleaning

Rg = Regrinding

C2 = 2nd Cleaning

C3 = 3rd Cleaning

C4 = 4th Cleaning

C5 = 5th Cleaning

Fig. 4-3 Each Cycle in Flowsheet of Locked Test

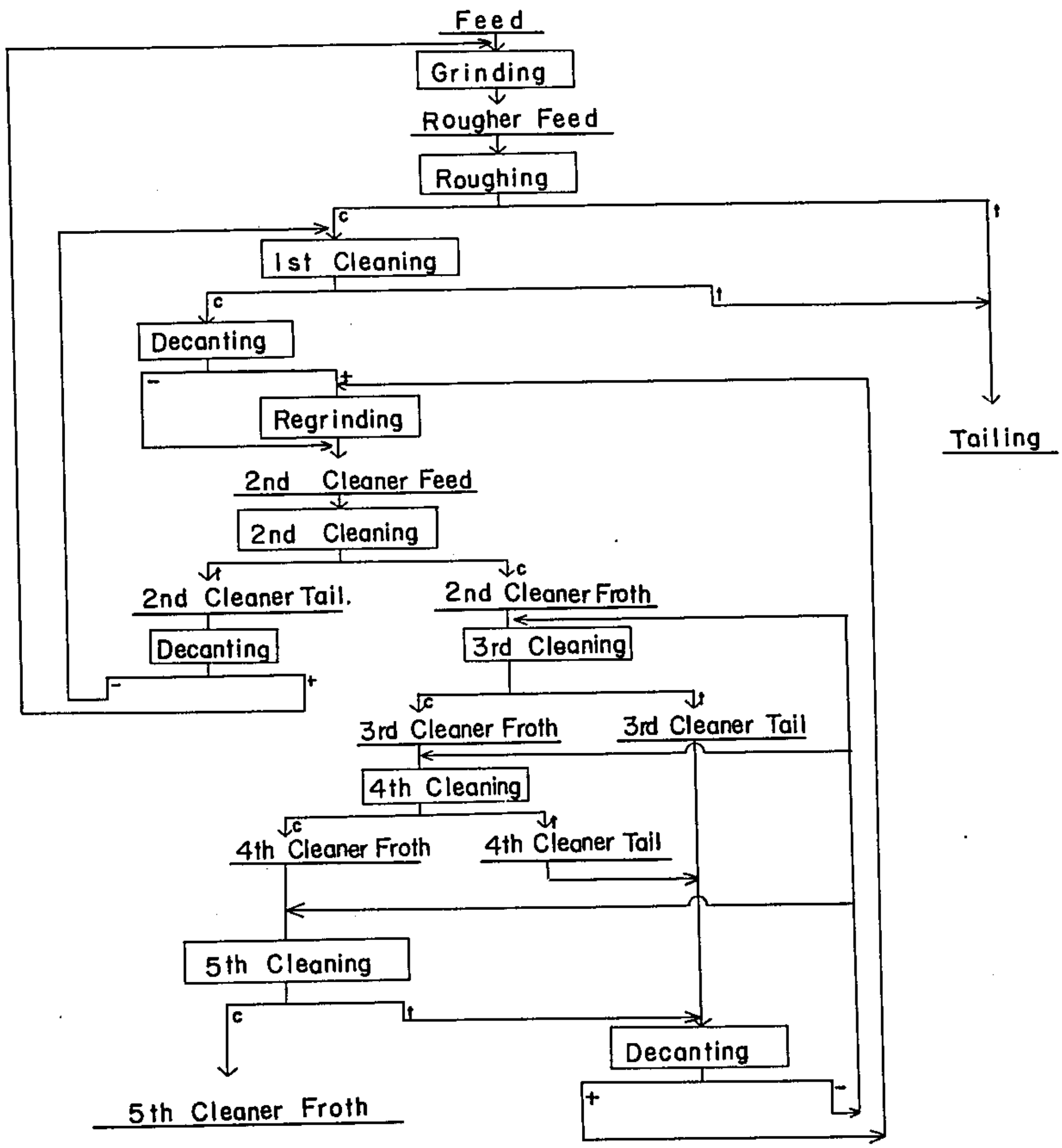


Table 4-11 Results of Locked Test

| Test No. | Products | Wt. (%) | Grade (%) Cu | S | Fe | Recovery (Cu %) | Common Condition |
|---|---|---|---|---|---|---|---|
| | Ore of Upper Zone | | | | | | Feed Size: |
| 90 | Feed | 100.00 | 0.90 | 5.0 | 5.3 | 100.0 | Upper – 200m. 82% |
| | Rougher Feed | 115.12 | 0.90 | | | 114.7 | Lower –200m. 70% |
| | 1st Cleaner Froth | 18.77 | 4.48 | | | 93.0 | |
| | 2nd Cleaner Feed | 23.63 | 4.02 | | | 105.0 | Regrinding Size: |
| | do. Forth | 8.51 | 9.60 | | | 90.3 | –400 mesh |
| | do. Tail.(M1) | 15.12 | 0.88 | 34.2 | 32.3 | 14.7 | |
| | 3rd Cleaner Froth | 6.23 | 12.54 | | | 86.4 | Flotation Time: |
| | do. Tail. (M2) | 2.28 | 1.56 | 37.6 | 35.4 | 3.9 | Rough. 15 min. |
| | 4th Cleaner Froth | 4.96 | 15.25 | | | 83 7 | 1st Clean. 10 min. |
| | do. Tail. (M3) | 1.27 | 1.94 | 37.6 | 35.2 | 2.7 | 2nd Clean. 8 min. |
| | 5th Cleaner Froth(C) | 3.65 | 19.37 | 41.1 | 31.5 | 78.3 | 3rd Clean. 5 min. |
| | do. Tail. (M4) | 1.31 | 3.74 | 38.6 | 35.0 | 5.4 | 4th Clean. 5 min. |
| | Combined M2 ~ M4 | 4.86 | 2.10 | | | 12.0 | 5th Clean. 5 min. |
| | Tailing | 96.35 | 0.20 | 3.6 | 4.3 | 21.7 | |
| | Ore of Lower Zone | | | | | | Reagents: |
| 99 | Feed | 100.00 | 0.87 | 5.6 | 5.5 | 100.0 | Lime 4,600 g/t |
| | Rougher Feed | 115.41 | 0.90 | | | 118.3 | Collector 280 g/t |
| | 1st Cleaner Froth | 18.77 | 4.59 | | | 98.5 | Frother 100 g/t |
| | 2nd Cleaner Feed | 23.81 | 4.21 | | | 114.8 | |
| | do. Froth | 8.40 | 10.03 | | | 96.5 | PH: |
| | do. Tail. (M1) | 15.41 | 1.04 | 34.8 | 32.7 | 18.3 | Rough 10.5 ~11.9 |
| | 3rd Cleaner Froth | 6.19 | 13.28 | | | 94.1 | 1st Clean. 10.1 ~12.1 |
| | do. Tail. (M2) | 2.21 | 0.94 | 38.7 | 36.2 | 2.4 | 2nd Clean. 11.1 ~11.8 |
| | 4th Cleaner Froth | 4.50 | 17.16 | | | 88.3 | 3rd Clean. 12.1 ~12.4 |
| | do. Tail. (M3) | 1.69 | 2.98 | 37.6 | 35.2 | 5.8 | 4th Clean. 12.1 ~12.4 |
| | 5th Cleaner Froth(C) | 3.36 | 20.85 | 40.5 | 30.8 | 80.2 | 5th Clean. 12.1 ~12.3 |
| | do. Tail(M4) | 1.14 | 6.24 | 39.2 | 34.9 | 8.1 | |
| | Combined M2 ~ M4 | 5.04 | 2.81 | | | 16.3 | |
| | Tailing | 96.64 | 0.18 | 4.4 | 4.7 | 19.8 | |

Table 4-12 Chemical Assay of the Copper Concentrate

| Assay | Concentrate of Upper Zone | Concentrate of Lower Zone |
|---|---|---|
| Cu (%) | 20. 08 | 21. 77 |
| Pb (%) | 0. 01 | 0. 01 |
| Zn (%) | 0. 01 | 0. 01 |
| S (%) | 41. 1 | 41. 3 |
| Fe (%) | 31. 5 | 31. 2 |
| As (%) | 0. 03 | 0. 12 |
| Sb (%) | 0. 04 | 0. 04 |
| Bi (%) | 0. 01 | 0. 01 |
| Ni (%) | 0. 02 | 0. 02 |
| MoS2 (%) | <0. 01 | <0. 01 |
| SiO2 (%) | 1. 7 | 0. 9 |
| Al2O3 (%) | 1. 0 | 0. 8 |
| Au (g/t) | 1. 3 | 1. 3 |
| Ag (g/t) | 19 | 17 |
| Hg (ppm) | <0. 2 | <0. 2 |

## 1-6 Settling Tests

The settling tests were done on the products from the locked tests.

### 1-6-1 Copper Concentrates

The results of the settling tests on the copper concentrates showed fairly good settling of them as shown on Table 4-13. The surface areas of the thickener required will be calculated as follows, by assuming the settling velocity as 0.25 m/h in 26.9 % of initial density with 200 % of safety;

$$\frac{2.72-0.41}{0.25} \times 200\ \% = 18.5\ m^2\ /h\text{-}t$$

### 1-6-2 Tailing

The settling test showed very unfavorable results as shown on Table 4-14.

The Table 4-15 shows the chemical analysis of the seaped clear water after keeping them for 24 hours but shows no problematical components to cause the water pollution.

## 1-7 Some Problems on Operation

As the samples were obtained from the drilled cores of the Sabedaung deposit, it was impossible to test for the coarse crushing.

Aside from this, the following problems should be put forth for further researches.

### 1-7-1 Slime

As the ores tested were drilled cores as stated above, the effects of slimes has not been sufficiently checked in the batch test.

Table 4-13 Results of the Settling Test of Copper Concentrate

| Feed Pulp | | Depth of Clear Water Formed (mm) | | | | | | Solid settled after 24 hours | |
|---|---|---|---|---|---|---|---|---|---|
| Water-Solid Ratio | Pulp Density (%) | Settling Time (minutes) | | | | | | Water-Solid Ratio | Pulp Density (%) |
| | | 2 | 4 | 6 | 8 | 10 | 15 | | |
| 2.72 | 26.9 | 9 | 18 | 25 | 31 | 36 | 45 | 0.41 | 7.10 |
| 1.84 | 35.2 | 7 | 13 | 18 | 22 | 25 | 28 | - | - |
| 1.22 | 45.1 | 5 | 9 | 12 | 15 | 16 | 16 | — | - |

Table 4-14 Results of the Settling Test of Tailing

| Feed Pulp | | Depth of Clear Water Formed (mm) | | | | | | Solid settled after 24 hours | |
|---|---|---|---|---|---|---|---|---|---|
| Water-Solid Ratio | Pulp Density (%) | Settling Time (minutes) | | | | | | Water-Solid Ratio | Pulp Density (%) |
| | | 10 | 20 | 30 | 40 | 50 | 60 | | |
| 3.79 | 20.9 | 13 | 25 | 37 | 48 | 59 | 69 | 1.00 | 49.9 |

Table 4-15 Analysis of Tailing Water

| Ion Concentration (ppm) | | | | | | PH |
|---|---|---|---|---|---|---|
| Cu | Pb | Zn | As | Fe | Hg | |
| 0.07 | 0.01 | 0.01 | 0.01 | 0.02 | <0.005 | 11.5 |

Consideration should be taken to this subject hereafter.

1-7-2 Regrinding

In view of the very fine texture of the copper minerals, it seems to be necessary to grind ore under 400 mesh to obtain the copper concentrate.

The regrinding is required for this purpose, of which method should be surveyed very causiously hereafter.

1-7-3 Dewatering of Concentrate

Because of the fine grain size of concentrate, the filtrating process will be difficult. Therefore, installation of a dryer should be taken into consideration.

# Chapter 2 Design of Pilot Mill

## 2-1 Specifications

A pilot mill plant of 50 t/d was designed, based upon the results of the metallurgical tests, in which a considerable allowance was given to its capacity in consideration of the possible variation of the grades and properties of ore. To say about the slime thickener, for instance, a larger size was considered, which might be too large for the pilot mill plant of 50 tons a day capacity. It had to be so, as no information was available from the samples obtained from the drilled cores regarding to the actual state of slimes.

Therefore, the design should be taken as more or less ideal one without the care for the actual requirement of the operation in this point.

### 2-1-1 Mill Feeds

Ore: The upper ore from the Sabedaung ore deposit.

Maximum size: 200 mm.

Work index 121 kwh/short ton

Specific gravity: 2.9

Slime content: 15 % maximum

### 2-1-2 Capacity

50 t/d

### 2-1-3 Average Working Time per Day

In crushing: 5 h/shift x 2 shift/d = 10 h/d

In grinding, flotation, and dewatering:

8 h/shift x 3 shift/d x 0.92 % of availability = 22 h/d

2-1-4 Ore Tonnage To Be Treated per Hour

In crushing: 5 t/h

In grinding, flotation, and dewatering: 2.3 t/h

2-1-5 Grinding Sizes

In the primary grinding: under 200 mesh 82 %

In the secondary grinding: under 400 mesh

2-1-6 Flotation Time

In roughing and primary cleaning: 25 min.

In the secondary cleaning and thereafter: 20 min.

2-1-7 Power

To be generated in the place by means of a diesel generator.

2-1-8 Water Supply

To be obtained from the Yama Stream.

2-2 The Final Design

The flow sheet, general arrangement and specifications of the equipments of the pilot mill plant with the capacity of 50 t/d are shown on Fig. 4-4, Fig. 4-5, and Table 4-16 respectively.

Fig. 4-4 Flowsheet of 50 T/D Pilot Mill

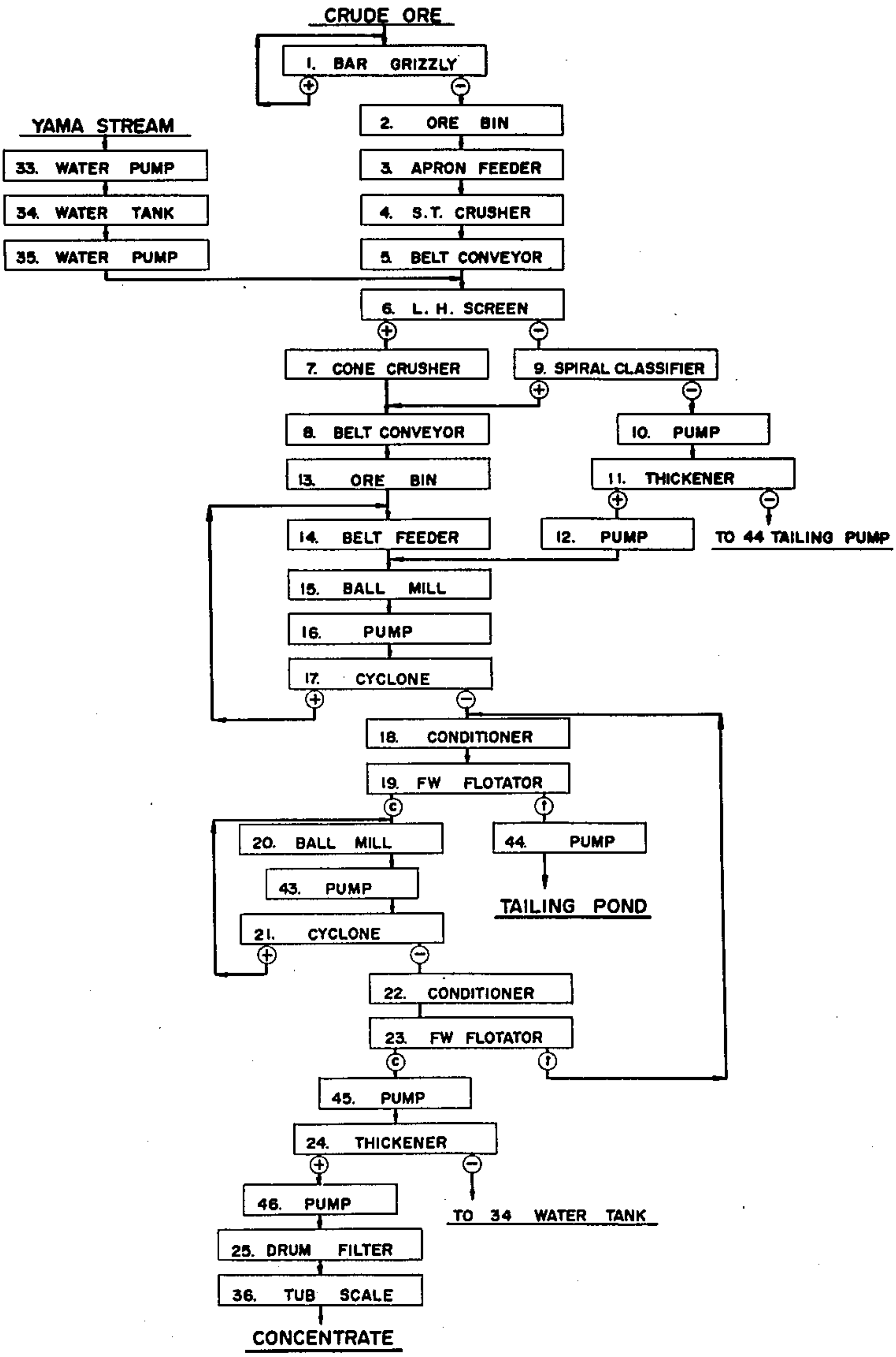
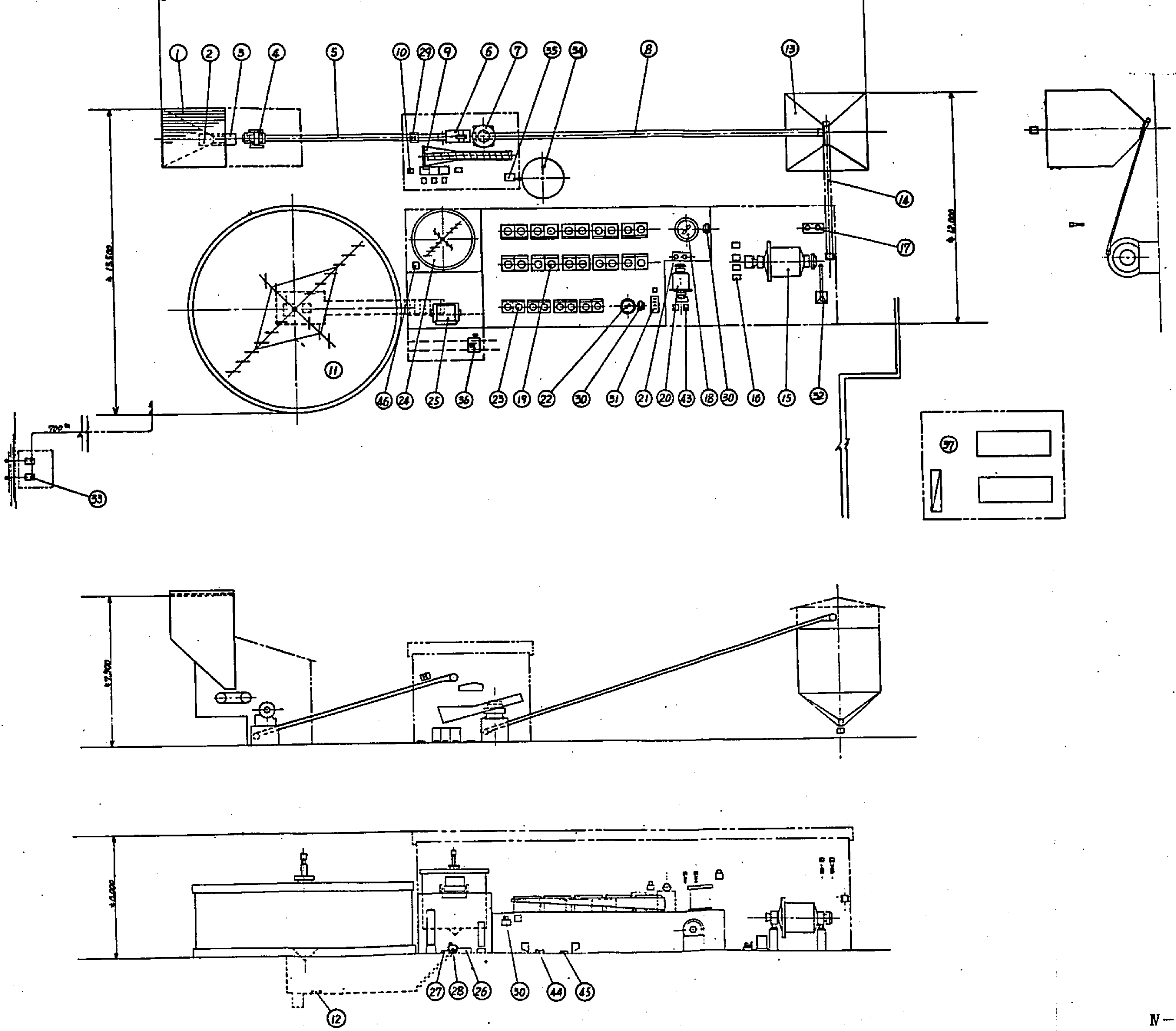


Fig. 4-5 General Arrangement of 50 T/D Pilot Mill



SCALE 1 : 200

| ITEM NO | MACHINE & EQUIPMENT | QUANTITY | SIZE | MOTOR KW |
|---|---|---|---|---|
| 46 | DIAPHRAGM PUMP | 1 | 25φ M/M | 0.75 |
| 45 | SLURRY PUMP | 2 | 40×25φ M/M | 1.1/@ |
| 44 | SLURRY PUMP | 2 | 75×50φ M/M | 3.5/@ |
| 43 | SLURRY PUMP | 2 | 40×25φ M/M | 1.1/@ |
| 42 | MACHINE TOOLS | 1 | | |
| 41 | SPARE PARTS | 1 | | |
| 40 | PIPING, VALVE ETC. | 1 | | |
| 39 | HOPPER, CHUTE, STAGE INTAKE TANK, TRAP ETC. | 1 | | |
| 38 | ELECTRICAL SWITCH BOARD, WIRING MATERIALS | 1 | | |
| 37 | GENERATOR | 2 | 187.5KVA | |
| 36 | TUB SCALE | 1 | 3TON CAP. | |
| 35 | WATER PUMP | 1 | 50×40φ M/M | 2.2 |
| 34 | WATER TANK | 1 | 2000φ×1500H M/M | |
| 33 | WATER PUMP | 2 | 100×75φ M/M | 11 |
| 32 | LIME BELT FEEDER | 1 | 150W×2000L M/M | 0.4 |
| 31 | REAGENT CUP FEEDER | 1 | 300φ M/M · 4 disc. | 0.2 |
| 30 | CUTTER SAMPLER | 3 | CUTTER 90W×250L M/M | 0.4 |
| 29 | HANGING MAGNET | 1 | 400φ M/M | 0.75 |
| 28 | COMPRESSOR | 1 | 0.3 M³/MIN 0.7kg/cm² | 2.2 |
| 27 | FILTRATE PUMP | 1 | 40φ M/M | 0.75 |
| 26 | VACUUM PUMP | 1 | Nash-type. 50φ M/M | 7.5 |
| 25 | DRUM VACUUM FILTER | 1 | 900φ×900L M/M | 0.75×2 |
| 24 | THICKENER | 1 | 3000φ×2,900H M/M | 0.75 |
| 23 | FLOTATOR | 8 CELLS 1 | FW #12 | 1.5/2 CELLS |
| 22 | CONDITIONER | 1 | 600φ×900H M/M | 0.75 |
| 21 | WET CYCLONE | 2 | 100φ M/M | |
| 20 | BALL MILL | 1 | 900φ×900L M/M | 11 |
| 19 | FLOTATOR | 20 CELLS 2 | FW #15 | 2.2/2 CELLS |
| 18 | CONDITIONER | 1 | 1000φ×1200H M/M | 2.2 |
| 17 | WET CYCLONE | 2 | 150φ M/M | |
| 16 | SLURRY PUMP | 4 | 75×50φ M/M | 3.5/@ |
| 15 | BALL MILL | 1 | 1,500φ×1,500L M/M | 37 |
| 14 | BELT FEEDER | 1 | 350W×7,000L M/M | 1.5 |
| 13 | FINE ORE BIN | 1 | 4000W×4000L×4500H M/M | |
| 12 | DIAPHRAGM PUMP | 1 | 25φ M/M | 0.75 |
| 11 | THICKENER | 1 | 10,500φ×2,800H M/M | 1.5 0.4 |
| 10 | SLURRY PUMP | 5 | 40×25φ M/M | 1.1/@ |
| 9 | SPIRAL CLASSIFIER | 1 | 450φ×9,000L M/M | 2.2 |
| 8 | BELT CONVEYOR | 1 | 350W×18,000L M/M | 1.5 |
| 7 | FINE CONE CRUSHER | 1 | 600φ M/M | 30 |
| 6 | LOW HEAD SCREEN | 1 | 600W×1,200L M/M | 2.2 |
| 5 | BELT CONVEYOR | 1 | 350W×10,000L M/M | 1.5 |
| 4 | SINGLE TOGGLE CRUSHER | 1 | 300W×235 M/M | 11 |
| 3 | APRON FEEDER | 1 | 600W×1,200L M/M | 2.2 |
| 2 | RECEIVING ORE BIN | 1 | 3000W×3000L×5000H M/M | |
| 1 | BAR GRIZZLY | 1 | 2,500W×2,500L M/M | |

Table 4-16 Specifications of Machines and Equipments for 50 T/D Pilot Mill

| Item No. | Machine and Equipment | Size m/m or Capacity | Motor KW | Q'ty | Remarks |
|---|---|---|---|---|---|
| 1 | Bar Grizzly | 2,500 x 2,500 | | 1 | Aperture 170m/m |
| 2 | Ore Bin | 25 T | | 1 | |
| 3 | Apron Feeder | 600 x 1,200 | 2.2 | 1 | |
| 4 | Single Toggle Crusher | 380 x 230 | 11.0 | 1 | Open set 30m/m |
| 5 | Belt Conveyor | 350 x 10,000 | 1.5 | 1 | |
| 6 | Low Head Screen | 600 x 1200 | 2.2 | 1 | Aperture 10m/m |
| 7 | Cone Crusher | 600 ø | 30.0 | 1 | Closed set 6m/m |
| 8 | Belt Conveyor | 350 x 18,000 | 1.5 | 1 | |
| 9 | Spiral Classifier | 450 ø x 4000 | 2.2 | 1 | |
| 10 | Pump | 40 ø x 25 ø | 1.1<br>1.5 | 5 | |
| 11 | Thickener | 10,500 x 2,800 | 0.4 | 1 | |
| 12 | Pump | Diaphragm 25 ø | 0.75 | 1 | |
| 13 | Ore Bin | 50 T | | 1 | |
| 14 | Belt Feeder | 350 x 7,000 | 1.5 | 1 | Slope 18° |
| 15 | Ball Mill | 1,500 ø x 1,500 | 37.0 | 1 | Ball charge 4.8T |
| 16 | Pump | 75 ø x 50 ø | 3.5 | 4 | |
| 17 | Cyclone | 150 ø | | 2 | |
| 18 | Conditioner | 1,000 ø x 1,200 | 2.2 | 1 | |
| 19 | FW Flotator | # 15 | 2.2/2 cells | 20 | |
| 20 | Ball Mill | 900 ø x 900 | 11.0 | 1 | Ball charge 1.1T |
| 21 | Cyclone | 100 ø | | 1 | |
| 22 | Conditioner | 600 ø x 900 | 0.75 | 1 | |
| 23 | FW Flotator | # 12 | 1.5/2 cells | | |
| 24 | Thickener | 3,000 ø x 2,700 | 0.75 | 1 | |
| 25 | Drum Filter | 900 ø x 900 | 0.75 | 1 | |
| 26 | Vacuum Pump | 600 mmHg x 1.5M³/min. | 7.5 | 1 | Receiver tank 400 ø x 1,200 |
| 27 | Filtrate Pump | 40 ø | 0.75 | 1 | |

(Continued)

| Item No. | Machine and Equipment | Size m/m or Capacity | Motor KW | Q'ty | Remarks |
|---|---|---|---|---|---|
| 28 | Compressor | 0. 7 $kg/cm^2$ x 0. 3 $M^3/min.$ | 2. 2 | 1 | |
| 29 | Hanging Magnet | 400 ø | 0. 75 | 1 | |
| 30 | Cutter Sampler | 50 x 250 | 0. 4 | 3 | |
| 31 | Reagent Cup Feeder | 300 ø x 4 Disc | 0. 2 | 1 | |
| 32 | Lime Belt Feeder | 150 x 2, 000 | 0. 4 | 1 | Hopper 600 x 600 x 600 |
| 33 | Water Pump | Multi-Stage 100 ø x 75 ø | 11. 0 | 2 | Water Head 50m |
| 34 | Water Tank | 2, 000 ø x 1, 500 | | 1 | |
| 35 | Water Pump | Multi-Stage 50 ø x 40 ø | 2. 2 | 1 | Water Head 10m |
| 36 | Tub Scale | 3 T | | 1 | |
| 37 | Generator | 187. 5KVA 400/200V-50 Hz | | 2 | |
| 38 | Electrical Switch, Board and Wiring Materials | | | 1 Set | |
| 39 | Chute, Hopper, Stage Intake Tank, Trap, etc. | | | 1 Set | |
| 40 | Piping and Valve etc. | | | 1 Set | |
| 41 | Spare Parts | | | | |
| -1 | Apron Pan and Chain Roller | | | 1 Set | |
| -2 | Jaw Plate, Cheek Plate, Toggle Plate, Spring | | | 1 Set | |
| -3 | Screen Plate | | | 3 | |
| -4 | Mill Liner, Ball | 1, 500 ø x 1, 500 | | 1 Set 4. 8 T | |
| -5 | Mill Liner, Ball | 900 ø x 900 | | 1 Set 1. 1 T | |
| -6 | Conditioner Impeller | 1000ø x 1200 | | 1 Set | |
| -7 | Lime Feeder Ratchet | | | 1 Set | |
| -8 | Flotator Shaft Assembly | # 15 | | 2 Sets | |
| -9 | | # 12 | | 2 Sets | |
| | Filter Cloth | | | 1 Set | |
| -10 | Pump Impeller | | | 4 Sets | |
| | Pump Liner | | | 4 Sets | |

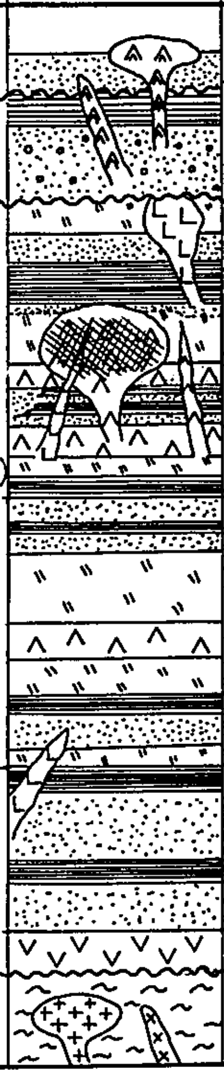
(Continued)

| Item No. | Machine and Equipment | Size m/m or Capacity | Motor KW | Q'ty | Remark |
|---|---|---|---|---|---|
| -11 | Diaphragm Pump Ball Valve | | | 4 Sets | |
| | Diaphragm Pump Diaphragm | | | 4 Sets | |
| -12 | Cyclone Rubber Liner | | | 2 Sets | |
| -13 | Pinch Valve Rubber Cylinder | | | 2 Sets | |
| 42 | Machine Tools | | | 1 Set | |
| 43 | Pump | 40 ø x 25 ø | 1. 1 | 2 | |
| 44 | Pump | 75 ø x 50 ø | 3. 5 | 2 | |
| 45 | Pump | 40 ø x 25 ø | 1. 1 | 2 | |
| 46 | Pump | Diaphragm 25 ø | 0. 75 | 1 | |

# APPENDICES

List of Tables

Table I-1 Generalized Columnar of Monywa Area



| GEOLOGICAL AGE | | FORMATION | ROCK FACIES | STRUCTURAL MOVEMENT | IGNEOUS ACTIVITY | MINERALIZATION |
|---|---|---|---|---|---|---|
| QUATERNARY | RECENT | ALLUVIUM (10-20m) | sandy soil<br>olivine basalt | SUBSIDING MOVEMENT BY STEP-WISE FAULTING (MONYWA BASIN) | Olivine (basalt) | |
| | PLEISTOCENE | KANGON F. (30 - 50m) | upper muddy member<br>lower coarse s.s. member<br>lower coarse sandstone | | Rhyolite (dome) | |
| TERTIARY | PLIOCENE | MAGYIGON F. (IRRAWADDY F.) (300 - 800m) | rhyolite dome with its pyroclastics | | | |
| | | | upper s.s. and mudstone.<br>rhyolite dyke and biot-porphyry and its pyroclastics | | Hb-biot porphyry<br>Biotite porphyry ( lavadome )<br>Qz-Biot-porphyry ( dyke )<br>Rhyolite ( dyke ) | COPPER MINERALIZATION (MONYWA AREA) |
| | | | s.s. and mudstone alternation | | | |
| | | | upper Hb-biot porphyry with its pyroclastics | | | |
| | MIOCENE | | middle s.s. and mudstone alternation | | | |
| | | | lower Hb-biot porphyry and its pyroclastics | | Hb-Biot porphyry. | |
| | | | lower s.s. mudstone alternation and rhyolite dykes | | Rhyolite, | |
| | MIOCENE | DAMAPALA F. (PEGU-GROUP) (Over 300m) | alternation of graded s.s. and laminated mudstone | | | |
| | OLIGOCENE | | andesite flow | | Andesite, | |
| CRETA-CEOUS | | BASEMENT | greenrocks<br>hornblende diorite(+)<br>granophyre dykes (x) | | | |

ss. - sandstone Hb - hornblende biot - biotite F. - formation ore body

mudstone sandstone tuff basalt rhyolite Hb-biot-porphyry andesite

Table I-2 Chemical Analysis of Rcok Samples

| Sample No. | K-100 | S-102 | L-4 |
|---|---|---|---|
| Location<br>Rock Name<br>% | Kyisindaung<br>Hornblende biotite porphyry<br>% | Sabedaung South DDH IP-2 (LN-3) (134-135m)<br>Hornblende biotite porphyry<br>% | Shwebontha<br>Rhyolite<br>% |
| $SiO_2$ | 64.31 | 62.00 | 80.46 |
| $TiO_2$ | 0.37 | 0.40 | 0.12 |
| $Al_2O_3$ | 17.64 | 17.87 | 11.72 |
| $Fe_2O_3$ | 1.57 | 1.26 | 0.10 |
| FeO | 2.29 | 2.29 | 0.22 |
| MnO | 0.10 | 0.13 | 0.01 |
| MgO | 2.38 | 2.49 | 0.08 |
| CaO | 3.33 | 2.94 | 0.10 |
| $Na_2O$ | 2.82 | 2.40 | 0.19 |
| $K_2O$ | 2.22 | 2.58 | 5.56 |
| $H_2O^+$ | 2.40 | 2.90 | 1.10 |
| $H_2O^-$ | 0.96 | 0.96 | 0.42 |
| $P_2O_5$ | 0.20 | 0.15 | 0.02 |
| S | 0.03 | 0.03 | 0.07 |
| Ignition loss | 0.02 | 1.56 | 0.45 |
| Total | 100.64 | 99.96 | 100.62 |

## Table I-3 Calculation Table for Reserve Estimation

| LOCATIONS | BLOCK No. | AREA ON EACH SECTION North-A m² | South-B m² | √AxB m² | Average m² | SECTION SPACE m | VOLUME m³ | S.C. | ORE RESERVE t | * Cu % | METAL CONTENT t | REMARK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SABEDAUDO | 1 | | 770 | (1/3) | 260 | 20 | 5,200 | 2.5 | 13,000 | 0.40 | 52.0 | |
| | 2 | 770 | 12,340 | 3,080 | 5,400 | 20 | 108,000 | " | 270,000 | 0.85 | 2,295.0 | |
| | 3 | 12,340 | 16,690 | 14,350 | 14,460 | 49 | 708,540 | " | 1,771,000 | 0.88 | 15,585.0 | |
| | 4 | 16,690 | 22,650 | 19,440 | 19,590 | 32 | 626,880 | " | 1,567,000 | 1.04 | 16,297.0 | |
| | 5 | 22,650 | 28,140 | 25,250 | 25,350 | 30 | 760,500 | " | 1,901,000 | 1.02 | 19,390.0 | |
| | 6 | 28,140 | 24,090 | 26,040 | 26,090 | 73 | 1,904,570 | " | 4,761,000 | 0.85 | 40,469.0 | |
| | 7 | 24,090 | 35,380 | 29,190 | 29,550 | 96 | 2,837,120 | " | 7,093,000 | 1.14 | 80,860.0 | |
| | 8 | 35,380 | 16,520 | 24,170 | 25,350 | 84 | 2,129,400 | " | 5,324,000 | 1.16 | 61,758.0 | |
| | 9 | 16,520 | 7,720 | 11,290 | 11,840 | 90 | 1,065,600 | " | 2,664,000 | 0.79 | 21,046.0 | |
| | 10 | 7,720 | | (1/3) | 2,570 | 55 | 141,350 | " | 353,000 | 0.85 | 3,001.0 | |
| | TOTAL (1) | | | | | | | | 25,717,000 | 1.01 | 260,753.0 | |
| KITSINDAUDO A - ORE BODY | 2 | | 2,500 | | 830 | 58 | 48,140 | 2.6 | 125,000 | 1.17 | 1,463.0 | |
| | 3 | 2,500 | 9,530 | 4,880 | 5,630 | 80 | 450,400 | " | 1,171,000 | 0.90 | 10,539.0 | |
| | 4 | 9,530 | 53,930 | 22,670 | 28,710 | 84 | 2,411,640 | " | 6,270,000 | 0.76 | 47,652.0 | |
| | 5 | 53,930 | 3,610 | 13,950 | 23,830 | 94 | 2,240,020 | " | 5,824,000 | 0.74 | 43,098.0 | |
| | 6 | 3,610 | 7,800 | 5,310 | 5,570 | 88 | 490,160 | " | 1,274,000 | 0.56 | 7,134.0 | |
| | 7 | 7,800 | 24,330 | 13,780 | 15,300 | 90 | 1,377,000 | " | 3,580,000 | 0.77 | 27,566.0 | |
| | 8 | 24,330 | 56,730 | 37,150 | 39,400 | 94 | 3,703,600 | " | 9,629,000 | 0.80 | 77,032.0 | |
| | 9 | 56,730 | 50,620 | 53,590 | 53,640 | 95 | 5,095,800 | " | 13,249,000 | 0.72 | 95,393.0 | |
| | 10 | 50,620 | 35,000 | 42,090 | 42,570 | 83 | 3,533,310 | " | 9,187,000 | 0.71 | 65,228.0 | |
| | 11 | 35,000 | 29,960 | 32,380 | 32,440 | 91 | 2,952,040 | " | 7,675,000 | 0.84 | 64,470.0 | |
| | 12 | 29,960 | | | 9,990 | 100 | 999,000 | " | 2,597,000 | 0.94 | 24,411.0 | |
| | TOTAL | | | | | | | | 60,581,000 | 0.77 | 463,986.0 | |
| KITSINDAUDO B - ORE BODY | 5 | | 11,830 | | 3,940 | 47 | 185,180 | 2.6 | 481,000 | 0.84 | 4,040.0 | |
| | 6 | 11,830 | 10,240 | 11,010 | 11,030 | 88 | 970,640 | " | 2,524,000 | 0.79 | 19,940.0 | |
| | 7 | 10,240 | 1,950 | 4,470 | 5,550 | 90 | 499,500 | " | 1,299,000 | 0.82 | 10,651.0 | |
| | 8 | 1,950 | | | 650 | 47 | 30,550 | " | 79,000 | 1.29 | 1,019.0 | |
| | TOTAL | | | | | | | | 4,383,000 | 0.81 | 35,650.0 | |
| KITSINDAUDO C - ORE BODY | 1 | | 5,750 | | 1,910 | 50 | 95,500 | 2.6 | 248,000 | 0.78 | 1,934.0 | |
| | 2 | 5,750 | 1,500 | 2,930 | 3,390 | 115 | 389,850 | " | 1,014,000 | 0.69 | 6,997.0 | |
| | 3 | 1,500 | 1,120 | 1,300 | 1,310 | 80 | 104,800 | " | 272,000 | 0.69 | 1,877.0 | |
| | 4 | 1,120 | | | 370 | 42 | 15,540 | " | 40,000 | 0.92 | 68.0 | |
| | TOTAL | | | | | | | | 1,574,000 | 0.71 | 11,176.0 | |
| | TOTAL (2) | | | | | | | | 66,538,000 | 0.77 | 510,812.0 | |
| TOTAL (1) + (2) | | | | | | | | | 92,255,000 | 0.84 | 771,565.0 | |

S.C. : Specific gravity ; * : Ore grade in the block.

## Table I-4 Calculation Table for Cu-Grade in each Block of Sabedaung Ore Deposit

| BLOCK No. | DRILL HOLE No. | m * | GRATE Cu % | m x Cu % |
|---|---|---|---|---|
| 1 | 28-C | 9.0 | 0.51 | 4.590 |
| | 28-L | 28.5 | 0.36 | 10.260 |
| TOTAL | | 37.5 | 0.40 | 14.850 |
| 2 | 28-C | 9.0 | 0.51 | 4.590 |
| | 28-L | 28.5 | 0.36 | 10.260 |
| | 28-A | 20.3 | 2.16 | 43.848 |
| | 28-D | 25.9 | 1.01 | 26.159 |
| | 28-E | 41.1 | 0.71 | 29.181 |
| | 28-F | 61.3 | 0.73 | 44.749 |
| | 28-G | 61.0 | 1.27 | 77.470 |
| | 28 | 132.9 | 0.81 | 107.649 |
| | 28-H | 91.4 | 0.64 | 58.496 |
| | 28-O | 21.3 | 0.81 | 17.253 |
| TOTAL | | 492.70 | 0.85 | 419.655 |
| 3 | 28-D | 25.9 | 1.01 | 26.159 |
| | 28-E | 41.1 | 0.71 | 29.181 |
| | 28-F | 61.3 | 0.73 | 44.749 |
| | 28 | 132.9 | 0.81 | 107.649 |
| | 28-H | 91.4 | 0.64 | 58.496 |
| | 28-B | 45.3 | 1.81 | 81.993 |
| | 28-O | 21.3 | 0.81 | 17.253 |
| | 28-I | 50.9 | 0.85 | 43.265 |
| | JS-3 | 94.0 | 0.71 | 66.740 |
| | 28-N | 68.6 | 1.17 | 80.262 |
| | JS-1 | 72.0 | 0.88 | 63.360 |
| TOTAL | | 704.7 | 0.88 | 619.107 |
| 4 | JS-1 | 72.0 | 0.88 | 63.360 |
| | 28-N | 68.6 | 1.17 | 80.262 |
| | JS-3 | 94.0 | 0.71 | 66.740 |
| | 28-I | 50.9 | 0.85 | 43.265 |
| | JS-8 | 54.0 | 1.02 | 55.080 |
| | " | 30.0 | 3.90 | 117.000 |
| | 28-K | 57.9 | 1.31 | 15.849 |
| | " | 11.3 | 0.36 | 4.068 |
| | " | 9.1 | 0.43 | 3.913 |
| | 28-J | 97.5 | 0.70 | 68.250 |
| | " | 18.3 | 0.34 | 6.222 |
| | 29-B | 21.2 | 1.37 | 29.044 |
| | " | 6.1 | 0.56 | 3.416 |
| TOTAL | | 590.9 | 1.04 | 616.469 |
| 5 | 29-B | 21.2 | 1.37 | 29.044 |

| BLOCK No. | DRILL HOLE No. | m * | GRATE Cu % | m x Cu % |
|---|---|---|---|---|
| 5 | 29-B | 6.1 | 0.56 | 3.416 |
| | 28-J | 97.5 | 0.70 | 68.250 |
| | " | 18.3 | 0.34 | 6.222 |
| | 28-K | 57.9 | 1.31 | 75.849 |
| | " | 11.3 | 0.36 | 4.068 |
| | " | 9.1 | 0.43 | 3.913 |
| | 29-A | 73.8 | 0.69 | 50.922 |
| | " | 5.8 | 0.46 | 2.668 |
| | JS-8 | 54.0 | 1.02 | 55.080 |
| | " | 30.0 | 3.90 | 117.000 |
| | 29 | 109.7 | 1.11 | 121.767 |
| | 29-C | 98.3 | 0.70 | 68.810 |
| TOTAL | | 593.0 | 1.02 | 607.009 |
| 6 | 29-C | 98.3 | 0.70 | 68.810 |
| | 29 | 109.7 | 1.11 | 121.767 |
| | JS-2 | 90.0 | 0.91 | 81.900 |
| | JS-7 | 126.0 | 0.88 | 110.880 |
| | JS-5 | 102.0 | 1.12 | 114.240 |
| | 23-A | 28.7 | 0.64 | 18.368 |
| | 23-B | 9.9 | 0.34 | 3.366 |
| | " | 9.4 | 0.39 | 3.666 |
| | 23 | 92.7 | 0.68 | 63.036 |
| | 23-C | 122.5 | 1.02 | 124.950 |
| | 23-D | 69.5 | 0.33 | 22.935 |
| TOTAL | | 858.7 | 0.85 | 733.918 |
| 7 | 23-A | 28.7 | 0.64 | 18.368 |
| | 23-B | 9.9 | 0.34 | 3.366 |
| | " | 9.4 | 0.39 | 3.666 |
| | 23 | 92.7 | 0.68 | 63.036 |
| | 23-C | 122.5 | 1.02 | 124.950 |
| | 23-D | 69.5 | 0.33 | 22.935 |
| | JS-4 | 58.0 | 1.60 | 92.800 |
| | JS-6 | 96.0 | 1.11 | 106.560 |
| | 30-B | 33.2 | 0.99 | 32.868 |
| | 30 | 117.7 | 1.10 | 129.470 |
| | 30-C | 169.5 | 1.24 | 40.180 |
| | 30-A | 159.6 | 1.97 | 314.412 |
| | 30-Q | 27.0 | 0.45 | 12.150 |
| TOTAL | | 993.7 | 1.14 | 1,134.761 |
| 8 | 30-B | 33.2 | 0.99 | 32.868 |
| | 30 | 117.7 | 1.10 | 129.470 |

| BLOCK No. | DRILL HOLE No. | m * | GRATE Cu % | m x Cu % |
|---|---|---|---|---|
| 8 | 30-C | 169.5 | 1.24 | 210.180 |
| | 30-A | 159.6 | 1.97 | 314.412 |
| | 30-Q | 27.0 | 0.45 | 12.150 |
| | JS-9 | 94.0 | 1.01 | 94.940 |
| | 31-A | 35.5 | 1.01 | 35.855 |
| | " | 14.9 | 0.37 | 5.513 |
| | 31 | 35.7 | 0.73 | 26.061 |
| | " | 27.4 | 0.48 | 13.152 |
| | 31-B | 70.7 | 0.75 | 53.025 |
| | " | 22.6 | 0.54 | 12.204 |
| | 31-C | 45.4 | 1.24 | 56.296 |
| | " | 6.1 | 0.42 | 2.562 |
| TOTAL | | 869.3 | 1.16 | 998.688 |
| 9 | 31-A | 35.5 | 1.01 | 35.853 |
| | " | 14.9 | 0.37 | 5.513 |
| | 31 | 35.7 | 0.73 | 26.061 |
| | " | 27.4 | 0.48 | 13.152 |
| | 31-B | 70.7 | 0.75 | 53.025 |
| | " | 22.6 | 0.54 | 12.204 |
| | 31-C | 45.4 | 1.24 | 56.296 |
| | " | 6.1 | 0.42 | 2.562 |
| | JS-10 | 24.0 | 0.51 | 12.240 |
| | " | 20.0 | 0.57 | 11.400 |
| | " | 12.0 | 0.58 | 6.960 |
| | 32-B | 53.2 | 1.32 | 70.224 |
| | " | 53.9 | 0.50 | 26.950 |
| | 32 | 22.1 | 0.51 | 11.271 |
| | " | 9.1 | 0.75 | 6.825 |
| | 32-E | 9.1 | 0.45 | 4.095 |
| | 32-C | 32.6 | 0.57 | 18.582 |
| | 32-D | 22.6 | 1.65 | 37.290 |
| TOTAL | | 516.9 | 0.79 | 410.505 |
| 10 | 32-B | 53.2 | 1.32 | 70.224 |
| | " | 53.9 | 0.50 | 26.950 |
| | 32 | 22.1 | 0.51 | 11.271 |
| | " | 9.1 | 0.75 | 6.825 |
| | 32-E | 9.1 | 0.45 | 4.095 |
| | 32-C | 32.6 | 0.57 | 18.582 |
| | 32-D | 22.6 | 1.65 | 37.290 |
| | 32-A | 15.8 | 0.67 | 10.586 |
| TOTAL | | 492.70 | 0.85 | 419.655 |

* : Delineated limit of the ore reserve.

# Table I-5 Calculation Table for Cu-Grade in each Block of Kyisindaung Ore Deposit

| | BLOCK No. | SECTION No. | SECTION AREA $m^2$ | Cu % | m x Cu % |
|---|---|---|---|---|---|
| A - ORE BODY | 3 | 2 | 2,500 | 1.17 | 2,925.00 |
| | | 3 | 9,530 | 0.84 | 8,005.20 |
| | | TOTAL | 12,030 | 0.90 | 10,930.20 |
| | 4 | 3 | 9,530 | 0.84 | 8,005.20 |
| | | 4 | 53,930 | 0.75 | 40,447.50 |
| | | TOTAL | 63,460 | 0.76 | 48,452.70 |
| | 5 | 4 | 53,930 | 0.75 | 40,447.50 |
| | | 5 | 3,610 | 0.73 | 2,635.30 |
| | | TOTAL | 57,540 | 0.74 | 43,082.80 |
| | 6 | 5 | 3,610 | 0.73 | 2,635.30 |
| | | 6 | 7,800 | 0.49 | 3,822.00 |
| | | TOTAL | 11,410 | 0.56 | 6,457.30 |
| | 7 | 6 | 7,800 | 0.49 | 3,822.00 |
| | | 7 | 24,330 | 0.87 | 21,167.10 |
| | | TOTAL | 32,130 | 0.77 | 24,983.10 |
| | 8 | 7 | 24,330 | 0.87 | 21,167.10 |
| | | 8 | 56,730 | 0.77 | 43,682.10 |
| | | TOTAL | 81,060 | 0.80 | 64,849.20 |
| | 9 | 8 | 56,730 | 0.77 | 43,682.10 |
| | | 9 | 50,620 | 0.67 | 33,915.40 |
| | | TOTAL | 107,350 | 0.72 | 77,597.50 |
| | 10 | 9 | 50,620 | 0.67 | 33,915.40 |
| | | 10 | 35,000 | 0.77 | 26,950.00 |
| | | TOTAL | 85,620 | 0.71 | 60,865.40 |
| | 11 | 10 | 35,000 | 0.77 | 26,950.00 |
| | | 11 | 29,960 | 0.94 | 28,162.40 |
| | | TOTAL | 64,960 | 0.84 | 55,112.40 |
| B - ORE BODY | 6 | 5 | 11,830 | 0.84 | 9,937.20 |
| | | 6 | 10,240 | 0.74 | 7,577.60 |
| | | TOTAL | 22,070 | 0.79 | 17,514.80 |
| | 7 | 6 | 10,240 | 0.74 | 7,577.60 |
| | | 7 | 1,950 | 1.29 | 2,515.50 |
| | | TOTAL | 12,190 | 0.82 | 10,093.10 |
| C - ORE BODY | 1 | 1 | 6,700 | 0.73 | 4,891.00 |
| | | 2 | 1,500 | 0.53 | 795.00 |
| | | TOTAL | 8,200 | 0.69 | 5,686.00 |
| | 2 | 2 | 1,500 | 0.53 | 795.00 |
| | | 3 | 1,120 | 0.92 | 1,030.40 |
| | | TOTAL | 2,620 | 0.69 | 1,825.40 |

| | SEC-TION | DRILL HOLE No. | m * | Cu % | m x Cu % |
|---|---|---|---|---|---|
| A - ORE BODY | 2 | 11-D | 22.9 | 1.15 | 26.33 |
| | | 11 | 3.8 | 1.27 | 4.83 |
| | TOTAL | | 26.7 | 1.17 | 31.16 |
| | 3 | 12-B | 28.2 | 0.76 | 21.43 |
| | | 12-C | 9.1 | 0.67 | 6.10 |
| | | 12 | 35.1 | 1.03 | 36.15 |
| | | 12-X | 27.4 | 0.82 | 22.47 |
| | | 12-D | 9.1 | 0.58 | 5.28 |
| | TOTAL | | 108.9 | 0.84 | 91.43 |
| | 4 | 13-B | 21.5 | 1.33 | 28.60 |
| | | 13 | 100.6 | 0.51 | 51.31 |
| | | 13-X | 100.1 | 1.04 | 104.10 |
| | | 13-D | 155.5 | 0.77 | 119.74 |
| | | 13-E | 88.7 | 0.70 | 62.10 |
| | | " | 135.6 | 0.63 | 85.43 |
| | TOTAL | | 602.0 | 0.75 | 451.28 |
| | 5 | 14-B | 8.5 | 0.52 | 4.42 |
| | | " | 13.7 | 0.35 | 4.80 |
| | | 14-C | 7.9 | 0.70 | 5.53 |
| | | 14 | 7.9 | 0.55 | 4.35 |
| | | 14-E | 12.2 | 0.67 | 8.17 |
| | | " | 20.6 | 0.51 | 10.51 |
| | | " | 16.8 | 1.54 | 25.87 |
| | TOTAL | | 87.6 | 0.73 | 63.65 |
| | 6 | 8 | 6.6 | 0.47 | 3.10 |
| | | " | 13.7 | 0.46 | 6.30 |
| | | 7 | 10.1 | 0.73 | 7.37 |
| | | 6 | 16.5 | 0.86 | 14.19 |
| | | " | 63.6 | 0.39 | 24.80 |
| | | 5 | 37.3 | 0.44 | 16.41 |
| | TOTAL | | 147.8 | 0.49 | 72.17 |
| | 7 | 15-Q | 29.0 | 0.53 | 15.37 |
| | | " | 24.4 | 1.01 | 24.64 |
| | | " | 32.0 | 0.89 | 28.48 |
| | | 15-P | 7.0 | 0.83 | 5.81 |
| | | " | 16.0 | 0.66 | 10.56 |
| | | 15-A | 12.3 | 0.47 | 5.78 |
| | | 15-B | 30.5 | 1.11 | 33.86 |
| | | 15 | 77.7 | 0.64 | 49.73 |
| | | 15-X | 114.7 | 1.08 | 123.88 |
| | TOTAL | | 343.6 | 0.87 | 298.11 |
| | 8 | 16-A | 50.3 | 1.98 | 99.59 |
| | | 16-B | 175.0 | 0.55 | 96.25 |
| | | 16-C | 106.7 | 0.78 | 83.23 |
| | | 16 | 209.1 | 0.66 | 138.01 |
| | | 16-X | 64.0 | 0.76 | 48.64 |
| | | 16-D | 23.2 | 0.71 | 16.47 |
| | | " | 39.0 | 0.88 | 34.32 |

| | SEC-TION | DRILL HOLE No. | m * | Cu % | m x Cu % |
|---|---|---|---|---|---|
| A - ORE BODY | TOTAL | | 667.3 | 0.77 | 516.51 |
| | 9 | 17-P | 42.9 | 0.40 | 17.16 |
| | | 17-A | 29.3 | 0.35 | 10.26 |
| | | 17-B | 171.6 | 0.55 | 94.38 |
| | | 17 | 21.3 | 0.54 | 11.50 |
| | | 17-X | 100.0 | 0.74 | 74.00 |
| | | " | 80.3 | 0.86 | 69.06 |
| | | 17-D | 86.3 | 0.91 | 78.53 |
| | TOTAL | | 531.7 | 0.67 | 354.89 |
| | 10 | 18-A | 7.1 | 0.72 | 5.11 |
| | | 18-B | 63.4 | 0.62 | 39.31 |
| | | 18-C | 23.5 | 0.53 | 12.46 |
| | | 18 | 38.3 | 0.78 | 29.87 |
| | | " | 40.2 | 0.67 | 26.93 |
| | | 18-X | 60.8 | 0.70 | 42.56 |
| | | " | 74.2 | 0.88 | 65.30 |
| | | 18-D | 61.3 | 1.22 | 74.79 |
| | | " | 61.0 | 0.58 | 35.38 |
| | TOTAL | | 429.8 | 0.77 | 331.71 |
| | 11 | 19-A | 86.0 | 1.09 | 93.74 |
| | | 19 | 35.1 | 0.60 | 21.06 |
| | | " | 32.0 | 0.93 | 29.76 |
| | | 19-D | 14.0 | 0.89 | 12.46 |
| | | " | 8.0 | 0.98 | 7.84 |
| | TOTAL | | 175.1 | 0.94 | 164.86 |
| B - ORE BODY | 5 | 14 | 30.5 | 0.98 | 29.89 |
| | | 14-X | 59.3 | 1.08 | 64.04 |
| | | 14-D | 65.5 | 0.55 | 36.03 |
| | TOTAL | | 155.3 | 0.84 | 129.96 |
| | 6 | 4 | 15.2 | 1.10 | 16.72 |
| | | " | 9.1 | 0.43 | 3.91 |
| | | 3 | 77.5 | 0.77 | 59.68 |
| | | 2 | 8.4 | 0.71 | 5.96 |
| | | " | 13.6 | 0.43 | 5.85 |
| | TOTAL | | 123.8 | 0.74 | 92.12 |
| C - ORE BODY | 1 | 10-B | 29.6 | 1.08 | 31.97 |
| | | 10-C | 31.4 | 0.50 | 15.70 |
| | TOTAL | | 61.0 | 0.73 | 47.67 |
| | 2 | 11-B | 15.2 | 0.44 | 6.69 |
| | | " | 17.1 | 0.67 | 11.46 |
| | | 11-C | 4.6 | 0.34 | 1.56 |
| | TOTAL | | 36.9 | 0.53 | 19.71 |
| | 3 | 12-C | 16.8 | 0.99 | 16.63 |
| | | " | 7.6 | 0.77 | 5.85 |
| | TOTAL | | 24.4 | 0.92 | 22.48 |

* : Delineated limit of the ore reserve.

# Table I-6 Summary of Drillings for Ore Reserve Estimation

Sheet 1

| No. | DRILL HOLE No. | LOCATION | TOTAL LENGTH feet | TOTAL LENGTH m | BEARING | INCLINATION | ELEVATION m | LOGGING DATE from | LOGGING DATE to | DELINEATED ORE ZONE FOR CALCULATION ( Cut off 0.3 % Cu ) from | to | feet | m | Cu % | Core recovery % | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | DDS-23 | SABEDAUNG | 834.00 | 254.5 | 0 | -90 | 145.5 | 12- 5-58 | 22- 7-58 | 170.0' | 474.0' | 304.0' | | 0.68 | 98.5 | |
| 2 | 23A | " | 535.00 | 163.1 | " | " | 100.6 | 1-12-65 | 27-12-65 | 76.0' | 170.0' | 94.0' | | 0.64 | 100.0 | |
| 3 | 23B | " | 511.50 | 155.9 | " | " | 117.4 | 27- 1-66 | 24- 2-66 | 126.5' | 159.0' | 32.5' | | 0.34 | 83.1 | |
| 4 | 23C | " | 510.48 | 155.6 | " | " | 104.0 | 28- 3-66 | 26- 4-66 | 60.0' | 462.0' | 402.0' | | 1.02 | 96.1 | |
| 5 | 23D | " | 514.67 | 156.7 | " | " | 89.0 | 14- 3-66 | 21- 4-66 | 74.5' | 302.5' | 228.0' | | 0.33 | 79.6 | |
| 6 | 23E | " | 514.00 | 156.7 | " | " | 79.8 | 16- 5-66 | 9- 6-66 | | | | | | | |
| 7 | 27 | " | 896.50 | 273.3 | " | " | 81.5 | 24- 4-59 | 6- 7-59 | 114.5' | 234.5' | 120.0' | | 0.49 | 33.7 | |
| 8 | 28 | " | 1,235.00 | 376.4 | " | " | 104.6 | 14- 2-59 | 4- 4-59 | 79.5' | 515.0' | 436.0' | | 0.81 | 62.5 | |
| 9 | 28A | " | 904.05 | 257.7 | " | " | 99.0 | 9- 5-59 | 20- 7-59 | 90.0' | 156.7' | 66.7' | | 2.16 | 80.1 | |
| 10 | 28B | " | 542.83 | 165.2 | " | " | 101.9 | 1-11-59 | 11- 1-60 | 120.0' | 268.6' | 148.6' | | 1.81 | 50.5 | |
| 11 | 28C | " | 1,003.00 | 305.7 | " | " | 91.4 | 17- 6-60 | 9-11-60 | 67.5' | 97.0' | 29.5' | | 0.51 | 65.4 | |
| 12 | 28D | " | 330.00 | 100.6 | " | " | 101.7 | 2- 9-60 | - | 65.0' | 150.0' | 85.0' | | 1.01 | 77.4 | |
| 13 | 28E | " | 292.5 | 89.2 | " | " | 99.3 | 11-10-60 | 1-11-60 | 85.0' | 220.0' | 135.0' | | 0.71 | 56.2 | |
| 14 | 28F | " | 326.00 | 99.4 | " | " | 102.5 | 17- 9-60 | 17-10-60 | 125.0' | 326.0' | 201.0' | | 0.73 | 57.1 | |
| 15 | 28G | " | 488.00 | 148.7 | " | " | 98.1 | 23- 9-60 | 9-11-60 | 86.0' | 286.0' | 200.0' | | 1.27 | 63.1 | |
| 16 | 28H | " | 505.00 | 153.9 | " | " | 102.7 | 21-11-60 | 22-12-60 | 85.0' | 385.0' | 300.0' | | 0.64 | 53.3 | |
| 17 | 28I | " | 644.60 | 196.5 | " | " | 114.6 | | | 109.0' | 276.0' | 167.0' | | 0.85 | 77.8 | |
| 18 | 28J | " | 700.00 | 213.4 | " | " | 137.1 | 14-11-60 | 23-11-60 | 105.0' | 425.0' | 320.0' | | 0.70 | 67.3 | |
| | | | | | | | | | | 465.0' | 525.0' | 60.0' | | 0.34 | 82.7 | |
| 19 | 28K | " | 295.00 | 89.9 | " | " | 84.2 | 29-11-60 | 16-12-60 | | | | | | | |
| 20 | 28L | " | 551.00 | 167.9 | " | " | 86.0 | | | 69.5' | 163.0' | 93.5' | | 0.36 | 71.9 | |
| 21 | 28M | " | 601.00 | 183.2 | " | " | 113.9 | | | 66.0' | 256.0' | 190.0' | | 1.31 | 69.9 | |
| | | | | | | | | | | 367.0' | 404.0' | 37.0' | | 0.36 | 67.8 | |
| | | | | | | | | | | 484.0' | 514.0' | 30.0' | | 0.43 | 45.7 | |
| 22 | 28N | " | 650.00 | 198.1 | " | " | 119.6 | - | - | 94.0' | 319.0' | 225.0' | | 1.17 | 64.4 | |
| 23 | 28O | " | 500.00 | 152.7 | " | " | 89.2 | 21- 6-66 | 23- 7-66 | 50.0' | 120.0' | 70.0' | | 0.81 | 41.9 | |
| 24 | 29 | " | 689.00 | 210.2 | " | " | 150.7 | 30- 4-58 | 3- 7-58 | 120.0' | 480.0' | 360.0' | | 1.11 | 62.6 | |
| 25 | 29A | " | 520.00 | 158.5 | " | " | 118.5 | 28- 7-66 | 7- 9-66 | 94.0' | 336.0' | 242.0' | | 0.69 | 68.8 | |
| | | | | | | | | | | 461.0' | 480.0' | 19.0' | | 0.46 | 89.5 | |
| 26 | 29B | " | 502.00 | 153.0 | " | " | 127.8 | 3-11-66 | 25-11-66 | 112.5' | 182.0' | 69.5' | | 1.37 | 71.2 | |
| | | | | | | | | | | 482.0' | 502.0' | 20.0' | | 0.56 | 92.5 | |
| 27 | 29C | " | 445.50 | 135.8 | " | " | 141.7 | 4-11-66 | 28-11-66 | 122.5' | 445.0' | 322.5' | | 0.70 | 82.0 | |
| 28 | 30 | " | 1,618.50 | 493.3 | " | " | 139.2 | 10- 7-58 | 27- 9-58 | 30.0' | 425.0' | 395.0' | | 1.10 | | |
| 29 | 30A | " | 944.00 | 287.0 | 220° | -45° | 99.1 | 10-10-58 | 15-12-58 | 82.8' | 606.5' | 523.7' | | 1.97 | 86.5 | |
| 30 | 30B | " | 520.00 | 158.5 | 0 | -90° | 111.8 | 10- 2-66 | 18- 3-66 | 75.0' | 184.0' | 109.0' | | 0.99 | 79.4 | |
| 31 | 30C | " | 715.50 | 219.9 | " | " | 118.1 | 5- 3-66 | 5- 7-66 | 53.0' | 609.0' | 556.0' | | 1.24 | 93.4 | |
| 32 | 31 | " | 770.50 | 234.8 | " | " | 123.1 | 26- 7-58 | 29- 9-58 | 161.0' | 278.0' | 117.0' | | 0.73 | 94.3 | |
| | | | | | | | | | | 408.0' | 498.0' | 90.0' | | 0.48 | 92.8 | |

| No. | DRILL HOLE No. | LOCATION | TOTAL LENGTH feet | TOTAL LENGTH m | BEARING | INCLINATION | ELEVATION m | LOGGING DATE from | LOGGING DATE to | DELINEATED ORE ZONE FOR CALCULATION ( Cut off 0.3 % Cu ) from | to | feet | m | Cu % | Core recovery % | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | DDS-31A | SABEDAUNG | 511.00 | 155.8 | 0 | -90° | 110.9 | 10-12-65 | 19- 1-66 | 75.0' | 191.5' | 116.5 | | 1.01 | 98.3 | |
| | | | | | | | | | | 311.0' | 360.0' | 49.0' | | 0.37 | 100.0 | |
| 34 | 31B | ″ | 537.0 | 163.7 | ″ | ″ | 104.6 | 6-11-66 | 21-12-66 | 68.0' | 300.0' | 232.0' | | 0.75 | 95.6 | |
| | | | | | | | | | | 463.0' | 537.0' | 74.0' | | 0.54 | 93.9 | |
| 35 | 31C | ″ | 500.00 | 152.4 | ″ | ″ | 93.4 | 23- 9-66 | 26-10-66 | 53.0' | 202.0' | 149.0' | | 1.24 | 78.2 | |
| | | | | | | | | | | 394.0' | 414.0' | 20.8' | | 0.42 | 87.5 | |
| 36 | 32 | ″ | 478.00 | 145.7 | ″ | ″ | 103.1 | 24- 9-66 | 31-10-66 | 82.0' | 154.5' | 72.5' | | 0.51 | 68.3 | |
| | | | | | | | | | | 296.0' | 326.0' | 30.0' | | 0.75 | 73.7 | |
| 37 | 32A | ″ | 570.70 | 173.9 | ″ | ″ | 85.9 | 25- 9-58 | 4-11-58 | 50.0' | 102.0' | 52.0' | | 0.67 | 16.3 | |
| 38 | 32B | ″ | 520.00 | 158.5 | ″ | ″ | 103.4 | 6-12-65 | 17-11-66 | 75.5' | 250.0' | 174.5' | | 1.32 | 98.7 | |
| | | | | | | | | | | 283.0' | 460.0' | 177.0' | | 0.50 | 98.8 | |
| 39 | 32C | ″ | 519.50 | 158.3 | ″ | ″ | 95.2 | 4- 3-66 | 21- 5-66 | 83.0' | 190.0' | 107.0' | | 0.57 | 72.0 | |
| 40 | 32D | ″ | 365.00 | 111.3 | ″ | ″ | 86.4 | 30- 5-66 | 20- 7-66 | 38.0' | 112.0' | 74.0' | | 1.65 | 61.5 | |
| 41 | 32E | ″ | 424.00 | 129.2 | ″ | ″ | 99.2 | 8- 8-66 | 14- 9-66 | 115.0' | 145.0' | 30.0' | | 0.45 | 80.0 | |
| 42 | 30Q | ″ | | 210.0 | ″ | ″ | 82.0 | 8- 2-73 | 20- 2-73 | 11.0m | 38.0 m | | 27.0 m | 0.45 | 100.0 | |
| 43 | 32Q | ″ | | 300.1 | ″ | ″ | 74.5 | 19- 1-73 | 4- 2-73 | | | | | | | |
| 44 | JS-1 | ″ | | 150.4 | ″ | ″ | 100.7 | 30-11-73 | 4-12-73 | 42.0m | 114.0 m | | 72.0 m | 0.88 | 96.4 | |
| 45 | 2 | ″ | | 151.1 | ″ | ″ | 120.2 | 3-12-73 | 9-12-73 | 24.5m | 114.5 m | | 90.0 m | 0.91 | 99.2 | |
| 46 | 3 | ″ | | 150.7 | ″ | ″ | 120.4 | 7-12-73 | 9-12-73 | 32.5m | 126.5 m | | 94.0 m | 0.71 | 100.0 | |
| 47 | 4 | ″ | | 151.6 | ″ | ″ | 125.5 | 13-12-73 | 16-12-73 | 29.5m | 87.5 m | | 58.0 m | 1.60 | 100.0 | |
| 48 | 5 | ″ | | 151.0 | ″ | ″ | 125.8 | 12-12-73 | 15-12-73 | 19.0m | 121.0 m | | 102.0 m | 1.12 | 100.0 | |
| 49 | 6 | ″ | | 150.4 | ″ | ″ | 124.7 | 20-12-73 | 24-12-73 | 32.0m | 128.5 m | | 96.0 m | 1.11 | 97.1 | |
| 50 | 7 | ″ | | 151.0 | ″ | ″ | 148.9 | 20-12-73 | 26-12-73 | 25.0m | 151.0 m | | 126.0 m | 0.88 | 100.0 | |
| 51 | 8 | ″ | | 151.0 | ″ | ″ | 85.3 | 3- 1-74 | 13- 1-74 | 18.0m | 72.0 m | | 54.0 m | 1.20 | 87.0 | |
| | | | | | | | | | | 120.0m | 150.0 m | | 30.0 m | 3.90 | 53.7 | |
| 52 | 9 | ″ | | 151.5 | ″ | ″ | 132.7 | 7- 1-74 | 13- 1-74 | 19.0m | 113.0 m | | 94.0 m | 1.01 | 100.0 | |
| 53 | 10 | ″ | | 151.0 | ″ | ″ | 108.6 | 22- 1-74 | 29- 1-74 | 25.0m | 49.0 m | | 24.0 m | 0.51 | 100.0 | |
| | | | | | | | | | | 69.0m | 89.0 m | | 20.0 m | 0.57 | 100.0 | |
| | | | | | | | | | | 105.0m | 117.0 m | | 12.0 m | 0.58 | 100.0 | |
| 54 | 11 | ″ | | 151.6 | ″ | ″ | 104.8 | 21- 1-74 | 28- 1-74 | | | | | | | |
| 55 | 12 | ″ | | 151.0 | ″ | ″ | 78.1 | 5- 2-74 | 11- 2-74 | 18.0m | 36.0 m | | 18.0 m | 1.62 | 96.7 | |
| 56 | DDK-1 | KYISINDAUNG | 373.50 | 113.7 | 270° | -50° | 120.5 | 15-11-58 | 17- 2-59 | | | | | | | |
| 57 | 2 | ″ | 1,002.80 | 305.7 | ″ | ″ | 139.7 | 29-12-58 | 17- 2-59 | 156.5' | 184.0' | 27.5' | | 0.71 | 87.3 | |
| | | | | | | | | | | 275.5' | 320.0' | 44.5' | | 0.43 | 91.0 | |
| 58 | 3 | ″ | 884.50 | 269.6 | ″ | ″ | 183.1 | 16- 1-59 | 4- 4-59 | 91.0' | 345.1' | 254.1' | | 0.77 | 32.7 | |
| 59 | 4 | ″ | 447.50 | 136.4 | ″ | ″ | 225.7 | 2- 6-59 | 15- 7-59 | 200.0' | 250.0' | 50.0' | | 1.10 | 92.0 | |
| | | | | | | | | | | 300.0' | 330.0' | 30.0' | | 0.43 | 91.7 | |
| 60 | 5 | ″ | 744.00 | 226.8 | 0 | -90° | 220.6 | 29- 3-68 | 2-10-68 | 621.5' | 744.0' | 122.5' | | 0.44 | 67.8 | |

TABLE I-6 SUMMARY OF DRILLINGS FOR ORE RESERVE ESTIMATION Sheet 3

| No. | DRILL HOLE No. | LOCATION | TOTAL LENGTH feet | TOTAL LENGTH m | BEARING | INCLINATION | ELEVATION m | LOGGING DATE from | LOGGING DATE to | DELINEATED ORE ZONE FOR CALCULATION (Cut off 0.3 % Cu) from | to | feet | m | Cu % | Core recovery % | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 61 | DDK- 6 | KYISINDAUNG | 882.50 | 269.0 | 0 | -90° | 177.0 | 4- 3-68 | 1- 8-68 | 442.0' | 496.0' | 54.0' | | 0.86 | 81.5 | |
| 62 | 7 | " | 390.00 | 118.8 | " | " | 129.6 | 22- 8-67 | 10-11-67 | 106.0' | 139.0' | 33.0' | | 0.73 | 83.3 | |
| 63 | 8 | " | 469.50 | 143.1 | " | " | 116.3 | 4- 9-67 | 7- 3-68 | 83.0' | 104.5' | 21.5' | | 0.47 | 95.3 | |
| | | | | | | | | | | 331.5' | 376.5' | 45.0' | | 0.46 | 80.0 | |
| 64 | 9 | " | 457.42 | 139.4 | " | " | 106.0 | 13- 2-67 | - | | | | | | | |
| 65 | 10 | " | 920.00 | 280.4 | " | " | 122.7 | 5- 1-71 | 9- 3-71 | | | | | | | |
| 66 | 10B | " | 456.00 | 139.0 | " | " | 132.5 | 20- 3-69 | 28- 4-69 | 105.5' | 202.5' | 97.0' | | 1.08 | 88.7 | |
| 67 | 10C | " | 605.00 | 184.4 | " | " | 133.7 | 9- 5-69 | 21- 6-69 | 311.0' | 414.0' | 103.0' | | 0.50 | 45.6 | |
| 68 | 10D | " | 790.00 | 240.8 | " | " | 128.7 | 9-11-71 | 10- 3-72 | | | | | | | |
| 69 | 10P | " | 1,025.00 | 313.9 | " | " | 84.6 | 31- 8-72 | 22- 9-72 | | | | | | | |
| 70 | 11 | " | 1,043.20 | 318.0 | " | " | 176.1 | 15- 3-72 | 22- 9-72 | 463.0' | 475.5' | 12.5' | | 1.27 | 76.0 | |
| | | | | | | | | | | 744.5' | 758.0' | 13.5' | | 1.20 | 82.3 | |
| 71 | 11B | " | 645.00 | 196.6 | " | " | 136.2 | 20- 1-69 | 7- 3-69 | 109.0' | 159.0' | 50.0' | | 0.44 | 92.0 | |
| | | | | | | | | | | 206.5' | 262.5' | 56.0' | | 0.67 | 38.7 | |
| 72 | 11C | " | 1,035.50 | 315.5 | " | " | 165.5 | 14-10-70 | 24-12-70 | 155.0' | 170.0' | 15.0' | | 0.34 | 98.3 | |
| 73 | 11D | " | 923.00 | 281.3 | " | " | 171.6 | 5-10-71 | 18- 2-72 | 430.0' | 505.0' | 75.0' | | 1.15 | 61.1 | |
| 74 | 12 | " | 835.00 | 254.5 | " | " | 223.8 | 5- 7-71 | 21-12-71 | 721.0' | 835.0' | 115.0' | | 1.03 | 82.9 | |
| 75 | 12B | " | 711.00 | 216.7 | " | " | 174.2 | 5- 5-69 | 9- 7-69 | 615.5' | 708.0' | 92.5' | | 0.76 | 71.4 | |
| 76 | 12C | " | 950.00 | 289.6 | " | " | 199.6 | 8-12-70 | 24- 4-71 | 230.0' | 285.0' | 55.0' | | 0.99 | 91.1 | |
| | | | | | | | | | | 350.0' | 375.0' | 25.0' | | 0.77 | 66.0 | |
| | | | | | | | | | | 610.0' | 640.0' | 30.0' | | 0.67 | 83.3 | |
| 77 | 12D | " | 724.00 | 220.7 | " | " | 206.7 | 24- 3-71 | 9- 6-71 | 505.0' | 535.0' | 30.0' | | 0.58 | 91.9 | |
| 78 | 12P | " | 1,065.00 | 324.6 | " | " | 94.7 | 30- 9-72 | 16-10-72 | | | | | | | |
| 79 | 12X | " | 965.00 | 293.5 | " | " | 229.4 | 20- 3-73 | 18- 2-74 | 609.6' | 699.6' | 90.0' | | 0.82 | 60.0 | |
| 80 | 13 | " | 1,110.83 | 338.6 | " | " | 239.8 | 1-12-72 | 10- 2-73 | 710.0' | 1,040.0' | 330.0' | | 0.51 | 78.2 | |
| 81 | 13B | " | 1,141.00 | 347.8 | " | " | 190.1 | 19-11-68 | 30- 1-69 | 557.0' | 627.5' | 70.5' | | 1.33 | 61.3 | |
| 82 | 13C | " | 765.00 | 233.2 | " | " | 236.3 | 20- 1-73 | 9- 3-73 | | | | | | | |
| 83 | 13D | " | 1,105.00 | 336.8 | " | " | 223.8 | 15- 1-71 | 23- 8-71 | 595.0' | 1,105.0' | 510.0' | | 0.77 | 91.1 | |
| 84 | 13E | " | 1,300.00 | 396.2 | " | " | 182.8 | 13- 7-72 | 21-11-72 | 395.0' | 686.0' | 291.0' | | 0.70 | 82.8 | |
| | | | | | | | | | | 762.5' | 1,207.5' | ,445.0' | | 0.63 | 92.1 | |
| 85 | 13G | " | | 400.3 | " | " | 110.2 | 26- 2-73 | 20- 3-73 | | | | | | | |
| 86 | 13X | " | 1,099.00 | 335.0 | " | " | 236.7 | 23- 2-73 | 4- 9-73 | 638.6' | 967.0' | 328.4' | | 1.04 | 95.1 | |
| 87 | 14 | " | 486.00 | 148.1 | " | " | 219.8 | 21-11-59 | 11- 1-60 | 160.0' | 260.0' | 100.0' | | 0.98 | 91.7 | |
| 88 | 14A | " | 584.00 | 178.0 | " | " | 144.7 | 18- 6-68 | 14-12-68 | | | | | | | |
| 89 | 14B | " | 694.00 | 211.5 | " | " | 185.6 | 18- 6-68 | 4- 9-68 | 346.0' | 374.0' | 28.0' | | 0.52 | 96.4 | |
| | | | | | | | | | | 544.0' | 589.0' | 45.0' | | 0.35 | 72.2 | |
| 90 | 14C | " | 780.00 | 237.7 | " | " | 234.5 | 4-10-69 | 12-12-69 | 651.5' | 677.5' | 26.0' | | 0.70 | 99.0 | |

| No. | DRILL HOLE No. | LOCATION | TOTAL LENGTH feet | TOTAL LENGTH m | BEARING | INCLINATION | ELEVATION m | LOGGING DATE from | LOGGING DATE to | DELINEATED ORE ZONE FOR CALCULATION ( Cut off 0.3 % Cu ) from | to | feet | m | Cu % | Core recovery % | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 91 | DDH-14Q | KYISINDAUNG | 800.00 | 243.8 | 0 | -90° | 178.2 | 6- 4-71 | 8- 6-71 | 85.0' | 300.0' | 215.0' | | 0.55 | 88.4 | |
| 92 | 14E | " | 1,170.00 | 356.6 | " | " | 151.4 | 11- 3-72 | 13- 6-72 | 436.0' | 476.0' | 40.0' | | 0.67 | 46.9 | |
| | | | | | | | | | | 747.5' | 815.0' | 67.5' | | 0.51 | 43.0 | |
| | | | | | | | | | | 950.0' | 1,005.0' | 55.0' | | 1.54 | 80.3 | |
| 93 | 14Q | " | 965.00 | 294.1 | " | " | 98.2 | 18-10-72 | 11-11-72 | | | | | | | |
| 94 | 14X | " | 968.00 | 294.7 | " | " | 179.1 | 8- 2-73 | 26- 2-73 | 110.5' | 305.0' | 194.5' | | 1.08 | 97.7 | |
| 95 | 15 | " | 1,050.00 | 320.0 | " | " | 249.9 | 18- 5-71 | 29- 7-71 | 275.0' | 430.0' | 155.0' | | 1.29 | 93.5 | |
| | | | | | | | | | | 600.0' | 855.0' | 255.0' | | 0.64 | 97.0 | |
| 96 | 15A | " | 872.00 | 265.8 | " | " | 144.6 | 28- 7-73 | 6- 9-73 | 300.5' | 341.0' | 40.5' | | 0.47 | 98.8 | |
| 97 | 15B | " | 875.00 | 266.7 | " | " | 175.1 | 23- 1-73 | 8- 2-73 | 425.0' | 525.0' | 100.0' | | 1.11 | 100.0 | |
| 98 | 15C | " | 950.00 | 289.6 | " | " | 213.4 | 12- 9-73 | 5- 5-74 | | | | | | | |
| 99 | 15D | " | 855.00 | 260.6 | " | " | 160.2 | 26- 6-71 | 14- 9-71 | | | | | | | |
| 100 | 15E | " | 806.50 | 245.9 | " | " | 135.6 | 12- 9-73 | 15-11-73 | 581.0' | 604.0' | 23.0' | | 0.83 | 95.7 | |
| 101 | 15F | " | 1,013.00 | 308.8 | " | " | 137.2 | 22-10-73 | 4-12-73 | 794.5' | 847.0' | 52.5' | | 0.66 | 100.0 | |
| 102 | 15Q | " | 935.00 | 285.0 | " | " | 132.8 | 2-12-72 | 13- 1-73 | 310.0' | 405.0' | 95.0' | | 0.53 | 100.0 | |
| | | | | | | | | | | 530.0' | 610.0' | 80.0' | | 1.01 | 100.0 | |
| | | | | | | | | | | 670.0' | 775.0' | 105.0' | | 0.89 | 98.9 | |
| 103 | 15X | " | 950.00 | 289.6 | " | " | 209.5 | 8- 8-73 | 25- 1-74 | 486.6' | 863.0' | 376.4' | | 1.08 | 93.2 | |
| 104 | 16 | " | 1,293.00 | 394.1 | " | " | 275.7 | 11- 9-73 | 23-10-73 | 496.0' | 1,182.0' | 686.0' | | 0.66 | 97.4 | |
| 105 | 16A | " | 1,024.00 | 312.1 | " | " | 173.1 | 5- 2-73 | 5- 4-73 | 510.0' | 675.0' | 165.0' | | 1.97 | 92.2 | |
| 106 | 16B | " | 1,175.00 | 358.1 | " | " | 208.7 | 27- 5-73 | 21- 8-73 | 555.5' | 1,129.6' | 574.1' | | 0.55 | 94.7 | |
| 107 | 16C | " | 1,074.00 | 327.2 | " | " | 251.9 | 21- 2-73 | 4- 4-73 | 660.0' | 1,010.0' | 350.0' | | 0.78 | 93.4 | |
| 108 | 16D | " | 1,000.50 | 305.0 | " | " | 153.2 | 8- 3-74 | 16- 5-74 | 478.6' | 554.6' | 76.0' | | 0.71 | | |
| | | | | | | | | | | 766.6' | 894.6' | 128.0' | | 0.88 | | |
| 109 | 16E | " | 1,167.00 | 355.7 | " | " | 151.2 | 7- 8-73 | 5- 9-73 | | | | | | | |
| 110 | 16G | " | | 201.6 | " | " | 118.2 | 23- 2-73 | 8- 3-73 | 531.0' | 741.0' | 210.0' | | 0.76 | | |
| 111 | 16X | " | 1,133.00 | 345.3 | " | " | 228.3 | 10- 3-73 | 4- 8-73 | 676.5' | 746.5' | 70.0' | | 0.54 | 59.5 | |
| 112 | 17 | " | 746.50 | 227.5 | " | " | 243.4 | 11- 9-71 | 18- 1-72 | 723.0' | 819.0' | 96.0' | | 0.35 | 89.6 | |
| 113 | 17A | " | 1,350.00 | 411.5 | " | " | 213.4 | 8-11-73 | 13- 3-74 | 725.5' | 1,288.6' | 563.1' | | 0.55 | 94.6 | |
| 114 | 17B | " | 1,288.60 | 392.8 | " | " | 223.4 | 11- 4-73 | 26- 7-73 | 484.0' | 601.6' | 117.6' | | 1.60 | | |
| 115 | 17D | " | 1,015.00 | 309.4 | " | " | 198.9 | 23- 5-74 | 8- 7-74 | 471.0' | 611.8' | 140.8' | | 0.40 | 99.7 | |
| 116 | 17P | " | 1,180.00 | 359.7 | " | " | 190.2 | 26- 4-73 | 7- 7-73 | 640.0' | 876.0' | 328.0' | | 0.74 | | |
| 117 | 17X | " | 1,351.00 | 411.8 | " | " | 247.0 | 27- 2-74 | 10- 4-74 | 1,087.6' | 1,351.0' | 263.4' | | 0.86 | | |
| 118 | 18 | " | 1,007.00 | 306.9 | " | " | 102.0 | 26- 3-74 | 6- 5-74 | 426.0' | 551.6' | 125.6' | | 0.78 | | |
| | | | | | | | | | | 764.0' | 896.0' | 132.0' | | 0.67 | | |
| 119 | 18A | " | 832.50 | 253.7 | " | " | 202.0 | 8- 5-74 | 4- 7-74 | 454.6' | 478.0' | 23.4' | | 0.72 | | |
| 120 | 18B | " | 988.50 | 301.3 | " | " | 182.4 | 15- 5-74 | 3- 6-74 | 193.6' | 401.6' | 208.0' | | 0.62 | | |

| No. | DRILL HOLE No. | LOCATION | TOTAL LENGTH feet | TOTAL LENGTH m | BEARING | INCLINATION | ELEVATION m | LOGGING DATE from | LOGGING DATE to | DELINEATED ORE ZONE FOR CALCULATION (Cutt off 0.3 % Cu) from | to | feet | m | Cu % | Core recovery % | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 121 | DDK-18C | KYISINDAUNG | 909.00 | 277.1 | 0 | -90° | 203.1 | 18- 2-74 | 15- 3-74 | 520.0' | 597.0' | 77.0' | | 0.53 | | |
| 122 | 18D | " | 1,002.60 | 305.4 | " | " | 184.7 | 22- 5-74 | 18- 6-74 | 453.0' | 654.0' | 201.0' | | 1.22 | | |
| | | | | | | | | | | 802.6' | 1,002.6' | 200.0' | | 0.58 | | |
| 123 | 18X | " | 1,057.50 | 322.3 | " | " | 196.9 | 22- 4-74 | 18- 5-74 | 437.6' | 637.0' | 199.4' | | 0.70 | | |
| | | | | | | | | | | 688.6' | 932.0' | 243.4' | | 0.88 | | |
| 124 | 19 | " | 710.00 | 216.4 | " | " | 167.4 | 27- 8-71 | 23-10-71 | 180.0' | 295.0' | 115.0' | | 0.60 | 77.8 | |
| | | | | | | | | | | 385.0' | 490.0' | 105.0' | | 0.93 | 94.4 | |
| 125 | 19A | " | | 301.1 | " | " | 161.2 | 25- 2-74 | 7- 3-74 | 62.0 m | 148.0 m | | 86.0 m | 1.09 | 100.0 | |
| 126 | 19D | " | | 301.6 | " | " | 163.6 | 11- 3-74 | 22- 3-74 | 113.0 m | 127.0 m | | 14.0 m | 0.89 | 100.0 | |
| | | | | | | | | | | 185.0 m | 193.0 m | | 8.0 m | 0.98 | 100.0 | |
| 127 | 21C | " | | 301.6 | " | " | 128.4 | 4- 2-74 | 11- 2-74 | | | | | | | |
| 128 | 21G | " | | 301.0 | " | " | 112.0 | 11- 3-73 | 23- 3-73 | | | | | | | |

## Table I-7 List of Rock Samples

Sheet 1

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| S - 1 | Sabedaung | Extrusive | Biotite porphyry | + | ++ | | | | | Reddish colored silicified biotite porphyry. |
| 2 | " | Ditto | Biotite prophyry | +++ | + | | | | | Pale green colored strong argillized porphyry. Biotite change to sericite. |
| 3 | " | Ditto | Silicified tuff | | ++ | | o | | | Pale reddish brown colored silicified tuff. |
| 4 | " | Ditto | Biotite Porphyry | + | ++ | + | | | | Pale gray colored silicified biotite prophyry. |
| 5 | " | Ditto | Biotite porphyry | ++ | + | ++ | | | | Pale gray colored quartz bearing biotite porphyry. Feldspar change to alunite. Feldspar: 1 cm |
| 6 | " | Ditto | Biotite porphyry | + | ++ | ++ | | | | Pale yellowish colored altered biotite porphyry, with quartz grained. |
| 7 | " | Ditto | Biotite porphyry | + | ++ | ++ | o | o | | Pale whitish gray argillized biotite porphyry. Biotite change to sericite. |
| 8 | " | Intrusive | Rhyolite | + | ++ | ++ | | | | Pale reddish brown colored weathered rhyolite. |
| 9 | " | Extrusive | Biotite porphyry | + | ++ | ++ | o | | | Pale yellowish colored biotite porphyry. Biotite: 7 mm Feldspar: 5 mm |
| 10 | " | Intrusive | Rhyolite | + | ++ | + | | | | Pale gray colored strong silicified massive rhyolite. |
| 11 | " | Ditto | Rhyolite | + | +++ | +++ | o | | | Pale gray colored plagio-rhyolite. |
| 12 | " | Extrusive | Biotite porphyry | ++ | ++ | + | | | | Pale whitish gray argillized biotite porphyry. |
| 13 | " | Ditto | Biotite porphyry | + | +++ | + | | | | Yellowish gray colored strong silicified biotite porphyry with hematite impregnated |
| 14 | " | Intrusive | Rhyolite | + | ++ | ++ | o | o | | Whitish gray colored fine compact silicified rhyolite with hematite vein boxwork and many gas pores. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| S - 15 | Sabedaung | Extrusive | Biotite porphyry | + | ++ | ++ | o | | | Pale white gray colored argillized biotite porphyry. Biotite change to muscovite. |
| 16 | " | Intrusive | Phyolite | | +++ | + | | | | Whitish gray colored silicified rhyolite. |
| 17 | " | Magyigon | Tuff breccia | | | | | | | Pale yellowish colored argillized tuff breccia. |
| 18 | " | Lava | Hornblende biotite porphyry | ++ | + | | | | | Whitish gray colored altered. |
| 19 | " | Extrusive | Biotite porphyry | ++ | + | | o | | | Pale gray colored weathered biotite porphyry. |
| 20 | " | Ditto | Biotite porphyry | + | ++ | ++ | | | | White colored argillized biotite porphyry. Biotite change to muscovite. |
| 21 | " | Magyigon | Tuff breccia | + | | | o | | | White colored silicified and argillized tuff breccia. |
| 22 | " | Ditto | Acidic tuff | + | | | | | | Light green colored fine grained acidic tuff. |
| 23 | " | Kangon | Sandstone | + | | | o | o | | Yellowish white colored coarse grained tuffaceous sandstone. |
| 24 | " | Magyigon | Sandstone | ++ | ++ | + | | | | Reddish colored sandstone with hematite boxwork. |
| 25 | " | Kangon | Sandstone | | | | | | | Whitish gray colored argillized tuffaceous sandstone. |
| 26 | " | Ditto | Sandstone | ++ | + | | | | | White colored argillized coarse grained tuffaceous sandstone. |
| 101 | IP-1 (LN-4) Depth 170m | Magyigon | Lapilli tuff | | | | | | o | Gray colored chloritized lapilli tuff. |
| 102 | IP-2 (LN-3) Depth 134m | Lava | Hornblende biotite porphyry | | | | | | | Gray colored weak argillized. Hornblende biotite porphyry. |

Sheet 3

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| K - 28 | Kyisindaung | Extrusive | Biotite porphyry | + | +++ | + | | | | Gray colored strong silicified biotite porphyry, weak epidotization. |
| 29 | " | Ditto | Biotite porphyry | + | ++ | + | o | o | | Gray colored silicified biotite with hematite boxwork porphyry. Biotite change to hematite with many gas pores. |
| 30 | " | Ditto | Biotite porphyry | + | ++ | + | o | | | Light gray colored silicified biotite porphyry. Biotite change to hematite. |
| 31 | " | Ditto | Biotite porphyty | + | + | + | | | | White gray colored silicified biotite porphyry. Biotite change to phlogopite Feldspar: 7 mm |
| 32 | " | Ditto | Biotite porphyry | + | ++ | + | | | | Pale yellowish colored altered and alunitized biotite porphyry. Biotite change to sericite. |
| 33 | " | Ditto | Biotite porphyry | + | ++ | ++ | o | o | | Pale gray colored altered biotite porphyry with hematitization. |
| 34 | " | Dyke | Rhyolite | + | ++ | + | o | o | | Reddish gray colored strong silicified brecciated rhyolite with hematite veinlet networks and many small gas pores. |
| 35 | " | Extrusive | Biotite porphyry | + | ++ | + | | | | Gray colored silicified, fine grained biotite porphyry with many small gas pores |
| 36 | " | Dyke | Rhyolite | + | +++ | + | | | | Reddish gray colored silicified brecciated rhyolite. |
| 37 | " | Extrusive | Biotite porphyry | + | ++ | ++ | | | | Brown colored altered biotite porphyry. |
| 38 | " | Ditto | Biotite porphyry | ++ | ++ | ++ | o | o | | Whitish gray colored strong altered biotite porphyry. Biotite change to sericite. |
| 39 | " | Ditto | Biotite porphyry | + | ++ | ++ | | | | Brown colored silicified and alunitized biotite porphyry. |
| 40 | " | Ditto | Biotite porphyry | ++ | + | +++ | | | | Light yellowish gray colored strong alunitized biotite porphyry, weak hematitization. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argl. | Sili. | Alu. | | | | |
| K - 41 | Kyisindaung | Extrusive | Biotite porphyry | ++ | + | | | | | Pale gray colored altered biotite porphyry. Hematite boxwork. |
| 42 | " | Ditto | Biotite porphyry | ++ | + | + | o | | | Pale yellowish gray colored altered biotite porphyry. Biotite change to hematite and medium alunitization. |
| 43 | " | Ditto | Biotite porphyry | ++ | + | ++ | | | | |
| 44 | " | Ditto | Biotite porphyry | ++ | + | + | | | | Gray colored strong silicified fine grained biotite porphyry. |
| 45 | " | Dyke | Rhyolite | ++ | + | | | | | Pale yellow colored argillized plagio-rhyolite. Hematite boxwork. |
| 46 | " | Extrusive | Biotite porphyry | ++ | ++ | | | | | Brownish red colored biotite porphyry. |
| 47 | " | Ditto | Biotite porphyry | +++ | | | | | | Gray colored argillized biotite porphyry. |
| 48 | " | Ditto | Biotite porphyry | ++ | + | + | | | | Gray colored silicified biotite porphyry. |
| 49 | " | Ditto | Biotite porphyry | +++ | + | +++ | | | | Gray colored strong silicified and alunitized fine compact rhyolite. |
| 50 | " | Ditto | Biotite porphyry | ++ | ++ | +++ | | | | Gray colored silicified strong alunitized grained biotite porphyry. |
| 51 | " | Ditto | Biotite porphyry | ++ | + | | | | | Pale yellowish gray colored fine compact silicified biotite porphyry. |
| 52 | " | Ditto | Biotite porphyry | ++ | ++ | +++ | | | | Whitish gray colored quartz porphyry. |
| 53 | " | Ditto | Biotite porphyry | + | ++ | ++ | | | | Pale gray colored strong alunitized biotite porphyry with hematitization. |
| 54 | " | Ditto | Biotite porphyry | + | ++ | + | | | | Gray colored, weathered biotite porphyry with hematite boxwork. |
| 55 | " | Dyke | Rhyolite | | +++ | + | o | | | Pale gray colored compact silicified rhyolite with many gas pores and many small gaspor. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| K - 56 | Kyisindaung | Extrusive | Biotite porphyry | + | ++ | ++ | | | | Weak epidotization. |
| 57 | " | Ditto | Biotite porphyry | | | | | | | Violet colored strong hematitized biotite porphyry. |
| 58 | " | Ditto | Biotite porphyry | + | ++ | +++ | o | | | Brown colored altered biotite porphyry.<br>Pinkish gray colored alunitized biotite porphyry. |
| 59 | " | Ditto | Biotite porphyry | + | ++ | ++ | | | | Pale violet gray colored, silicified and alunitized biotite porphyry with many small gas pores |
| 60 | " | Ditto | Biotite porphyry | ++ | + | + | | | | Pale brown colored altered biotite porphyry. |
| 61 | " | Ditto | Biotite porphyry | + | ++ | + | | | | Pale reddish gray colored silicified and argillized biotite porphyry texture with many small gas pores and malachite stains. |
| 62 | " | Ditto | Brecciated Biotite porphyry | + | ++ | | o | | | Reddish brown colored brecciated pyro-clastic rock, breccia fragment angular to subangular matrix change to iron gossan. |
| 63 | " | Dyke | Basalt | | | | | | | Dark gray colored weathered basalt. |
| 64 | " | Lava | Hornblende biotite porphyry | + | + | ++ | | | | Pale gray colored silicified and argillized hornblende biotite porphyry. |
| 100 | " | Lava | Biotite porphyry | | | | | | o | Gray colored fresh hornblende biotite porphyry. |
| Kw - 65 | Kyadwintaung | Lava | Hornblende biotite porphyry | | | | | | | Brown colored weathered. Hornblende biotite porphyry. |
| 66 | " | Ditto | Hornblende biotite porphyry | | | | | | | ditto |
| 67 | " | Magyigon | Sandstone | | | | | | | Whitish gray colored medium grained sandstone |
| 68 | " | Ditto | Sandstone | | | | | | | Ditto |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| Kw - 69 | Kyadwintaung | Lava | Hornblende biotite porphyry | ++ | | | | | | Whitish yellow colored hornblende decomposed biotite porphyry. Biotite is fresh. Feldspar change to kaoline. |
| 70 | " | Ditto | Hornblende biotite porphyry | + | + | | | | | Gray colored decomposed biotite porphyry with hematite network and small gas pores. |
| 71 | " | Extrusive | Biotite porphyry | + | ++ | | o | | | Gray colored silicified biotite porphyry with chalcedonic quartz grains. |
| 72 | " | Ditto | Biotite porphyry | + | + | | o | | | Pale pinkish colored altered quartz porphyry with chalcedonic quartz grains and small gas pores. |
| 73 | " | Ditto | Biotite porphyry | + | + | | | | | Dark gray colored strong hematitized biotite porphyry with chalcedonic quartz grains. |
| 74 | " | Ditto | Biotite porphyry | + | + | | | | | Ditto |
| 75 | " | Ditto | Biotite porphyry | | | | | | | Ditto |
| 76 | " | Ditto | Biotite porphyry | + | ++ | | o | | | Dark gray colored fine compact silicified biotite porphyry with hematite veinlet network. |
| 77 | " | Ditto | Biotite porphyry | + | ++ | | o | | | Reddish and reddish gray colored biotite porphyry. |
| 78 | " | Ditto | Biotite porphyry | + | ++ | | | | | Ditto |
| 79 | " | Magyigon | Sandstone | | + | | | | | Gray colored silicified fine grained sand-stone with hematite veinlet network. |
| 80 | " | Extrusive | Biotite porphyry | | | | | | | Brown colored silicified biotite porphyry. |
| 81 | " | Ditto | Biotite porphyry | + | ++ | | | | | Gray colored silicified brecciated biotite porphyry. |
| 82 | " | Ditto | Biotite porphyry | + | ++ | | o | | | Brownish gray colored silicified.:ite Feldspar change to limonite. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| Kw - 83 | Kyadwintaung | Extrusive | Biotite porphyry | | | | | | | Brownish gray colored silicified. Feldspar change to limonite. |
| 84 | " | Ditto | Biotite porphyry | | | | | | | Ditto |
| 85 | " | Ditto | Biotite porphyry | | | | | | | Ditto |
| 86 | " | Ditto | Biotite porphyry | | | | | | | Ditto |
| 87 | " | Ditto | Biotite porphyry | | | | | | | Ditto |
| 88 | " | Ditto | Biotite porphyry | | | | | | | Ditto |
| 89 | " | Ditto | Biotite porphyry | + | + | | | | | Brownish gray colored silicified biotite porphyry. |
| 90 | " | Ditto | Biotite porphyry | | | | | | | Ditto |
| 91 | " | Ditto | Biotite Porphyry | + | ++ | | o | | | Pale Yellowish gray colored silicified biotite porphyry.Feldspar change to kaoline |
| 92 | " | Lava | Hornblende biotite porphyry | | | | | | | Brown colored weathered biotite porphyry. |
| 93 | " | Extrusive | Biotite porphyry | + | + | | | | | Reddish gray colored altered biotite porphyry. |
| 94 | " | Lava | Hornblende biotite porphyry | | | | | | | Yellowish gray colored weathered. |
| 95 | " | Ditto | Hornblende biotite porphyry | | | | | | | |
| 96 | " | Kangon | Sandstone | | | | | | | Whitish yellow colored coarse grained sandstone |
| 97 | " | Ditto | Sandstone | | | | | | | Ditto |
| 98 | " | Ditto | Sandstone | | | | | | | Ditto |
| 99 | " | Ditto | Sandstone | | | | | | | Ditto |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| L - 1 | Letpadaung | Extrusive | Rhyolite | | ++ | | | | | |
| 2 | " | Ditto | Rhyolite | | ++ | | o | | | White gray colored silicified rhyolite with flow stracture. |
| 3 | " | Ditto | Rhyolite | | ++ | | | | | |
| 4 | " | Ditto | Rhyolite | | ++ | | | | | |
| 5 | " | Ditto | Rhyolite | | ++ | | | | o | |
| 6 | " | Magyigon | Tuff breccia | + | + | | | | | Gray colored, silicified tuff breccia. |
| 7 | " | Ditto | Sandstone | + | ++ | | o | | | Gray colored medium grained silicified sandstone. |
| 8 | " | Extrusive | Biotite porphyry | + | + | +++ | | | | Pale gray colored stroog alunitized and silicified biotite porphyry. |
| 9 | " | Ditto | Biotite porphyry | | | | | | | Brown colored, silicified and strong alunitized biotite porphyry, |
| 10 | " | Ditto | Biotite porphyry | + | ++ | +++ | | | | |
| 11 | " | Ditto | Rhyolite | + | ++ | +++ | o | | | Strong silicified brecciated. |
| 12 | " | Ditto | Biotite porphyry | | | | | | | Reddish gray colored silicified and alunitized biolite porphyry. |
| 13 | " | Ditto | Biotite porphyry | + | + | + | | | | Pale grayish yellow colored silicified biotite porphyry. Weak alunitization. |
| 14 | " | Ditto | Biotite porphyry | + | ++ | +++ | | | | Yellowish gray colored silicified and weathered quartz porphyry. Strong alunitization. |
| 15 | " | Ditto | Biotite porphyry | | +++ | +++ | o | o | | Pale reddish gray colored altered biotite porphyry. Biotite change to hematite. Strong alunitized and hematite veinlet. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| L - 16 | Letpadaung | Extrusive | Biotite porphyry | ++ | ++ | + | o | | | Pale yellowish brown colored altered biotite porphyry. Weak alunitization. |
| 17 | " | Ditto | Biotite porphyry | ++ | + | + | o | | | Whitish gray colored altered biotite porphyry with hematite boxwork. Biotite change to muscovite. |
| 18 | " | Ditto | Biotite porphyry | + | ++ | ++ | o | | | Pale gray colored hightly alunitized and silicified biotite porphyry. Medium alnitization. |
| 19 | " | Ditto | Biotite porphyry | + | ++ | + | o | o | | Silicified and strongly hematitized violet colored biotite porphyry. |
| 20 | " | Ditto | Biotite porphyry | + | + | + | | | | White and violet colored altered biotite porphyry. Feldspar change to alunite. |
| 21 | " | Ditto | Biotite porphyry | + | ++ | | | | | Pale violet colored coarse grained biotite-quartz porphyry. |
| 22 | " | Ditto | Biotite porphyry | ++ | + | | | | | Pale orange colored altered biotite porphyry. |
| 23 | " | Ditto | Biotite porphyry | + | + | + | | | | Pale gray colored silicified biotite porphyry. Weak alunitization.<br>Biotite: 5 mm<br>Feldspar: 3 mm |
| 24 | " | Ditto | Biotite porphyry | + | + | + | o | | | Brown colored altered biotite porphyry. |
| 25 | " | Ditto | Biotite porphyry | + | ++ | ++ | | | | Gray colored banding silicified biotite porphyry. |
| 26 | " | Ditto | Biotite porphyry | ++ | ++ | ++ | o | | | Grayish white colored silicified and alunitized biotite porphyry. |
| 27 | " | Ditto | Biotite porphyry | ++ | + | | | | | Yellowish white colored argillized biotite porphyry. |
| 28 | " | Ditto | Biotite porphyry | + | ++ | | | | | Reddish gray colored silicified biotite-quartz porphyry with many small gas pores. Biotite change to hematite. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| L - 29 | Letpadaung | Extrusive | Biotite porphyry | + | + | | | | | Reddish gray colored silicified biotite-quartz porphyry with many small gas pores. Biotite change to hematite. |
| 30 | " | Ditto | Biotite porphyry | | + | | | | | Ditto |
| 31 | " | Ditto | Biotite porphyry | | + | | | | | Ditto |
| 32 | " | Ditto | Biotite porphyry | | + | | | | | Ditto |
| 33 | " | Ditto | Biotite porphyry | ++ | + | + | o | | | Pale orange colored altered biotite porphyry with alunitization. |
| 34 | " | Ditto | Biotite porphyry | + | ++ | | | | | Yellowish white colored silicified biotite porphyry. |
| 35 | " | Dyke | Rhyolite | | +++ | | o | | | Pale gray colored silicified rhyolite. |
| 36 | " | Extrusive | Biotite porphyry | + | + | | | | | Brownish gray colored argillized biotite porphyry. |
| 37 | " | Ditto | Biotite porphyry | + | + | | | | | Pale gray colored coarse grained argillized biotite porphyry. Plagionite change to kaolinite. |
| 38 | " | Ditto | Biotite porphyry | + | + | | o | | | Reddish gray colored silicified biotite porphyry. Biotite (4 mm) change to sericite. |
| 39 | " | Ditto | Biotite porphyry | + | ++ | ++ | | | | Brown colored silicified and alunitized biotite prophyry. |
| 40 | " | Ditto | Biotite porphyry | + | ++ | +++ | o | | | Pale reddish gray colored biotite porphyry. Strong alunitization. |
| 41 | " | Ditto | Biotite porphyry | | | | | | | Ditto |
| 42 | " | Ditto | Biotite porphyry | | | | | | | Whitish gray colored compact silicified rhyolite with small gas pores. |
| 43 | " | Ditto | Biotite porphyry | + | + | | | | | Pale gray colored argillized biotite porphyry. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| L - 44 | Letpadaung | Extrusive | Biotite porphyry | + | ++ | + | o | o | | Reddish gray colored, hematitized and alunitized biotite porphyry. |
| 45 | " | Ditto | Biotite porphyry | ++ | + | | | | | Brown colored argillized biotite porphyry. |
| 46 | " | Ditto | Biotite porphyry | + | ++ | | | | | Pink spotted gray colored silicified and strong alunitized biotite porphyry. |
| 47 | " | Ditto | Biotite porphyry | + | + | | | | | Brownish gray colored silicified and argillized biotite porphyry. |
| 48 | " | Ditto | Biotite porphyry | + | + | | | | | Reddish gray colored weathered biotite porphyry. |
| 49 | " | Ditto | Biotite porphyry | ++ | + | | | | | White colored argillized biotite porphyry. |
| 50 | " | Ditto | Biotite porphyry | +++ | | | | | | White colored stroog argillized biotite porphyry. |
| 51 | " | Ditto | Biotite porphyry | ++ | + | | o | | | Pale gray colored argillized biotite porphyry. |
| 52 | " | Ditto | Biotite porphyry | | | | | | | Ditto |
| 53 | " | Ditto | Biotite porphyry | | | | | | | |
| 54 | " | Ditto | Biotite porphyry | | | | | | | Whitish yellow colored weathered biotite porphyry.<br>Biotite: 3 mm<br>Feldspar: 7 mm |
| 55 | " | Lava | Hornblende biotite porphyry | + | + | | | | | |
| 56 | " | Ditto | Biotite porphyry | | | | | | | Pale reddish gray colored hornblende biotite porphyry.<br>Biotite change to muscovite.<br>Plagioclase change to alunite. |
| 57 | " | Ditto | Biotite porphyry | + | ++ | + | | | | Pale gray colored weathered biotite porphyry. Biotite change to phlogopite. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| L - 58 | Letpadaung | Extrusive | Biotite porphyry | + | ++ | +++ | o | | | Pale violet colored fine grained altered fine tuffaceous sandstone with hematite boxwork. |
| 59 | " | Dyke | Rhyolite | | +++ | +++ | o | o | | Pale gray colored brecciated strong silicified and alunitized rhyolite. |
| 60 | " | Extrusive | Biotite porphyry | | +++ | +++ | o | | | Reddish violet colored strong altered biotite porphyry. |
| 61 | " | Ditto | Biotite porphyry | + | ++ | ++ | | | | Pale violet colored altered biotite porphyry Strong alunitization. |
| 62 | " | Ditto | Biotite porphyry | | +++ | +++ | | | | Grayish white colored silicified and alunitized biotite porphyry. Feldspar change to alunite. |
| 63 | " | Ditto | Biotite porphyry | ++ | + | | | | | Whitish gray colored weathered and altered biotite porphyry. Biotite change to muscovite. Weak alunitization. |
| 64 | " | Dyke | Brecciated rhyolite | | +++ | ++ | o | o | | Pale brown colored silicified rhyolite with hematite boxwork. |
| 65 | " | Extrusive | Biotite porphyry | + | ++ | ++ | o | | | Violet colored silicified and hematitized biotite porphyry. Weak argillization. |
| 66 | " | Dyke | Rhyolite | | +++ | + | | | | Reddish gray colored silicified and brecciated rhyolite. |
| 67 | " | Extrusive | Biotite porphyry | | | | | | | Pale gray colored strong alunitized silicified biotite porphyry. |
| 68 | " | Ditto | Biotite porphyry | + | ++ | | | | | Violet colored silicified and hematitized biotite porphyry. Weak alunitization. |
| 69 | " | Ditto | Biotite porphyry | + | + | | | | | Brownish gray colored biotite porphyry. |
| 70 | " | Ditto | Biotite porphyry | + | + | | | | | Ditto |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argl. | Sili. | Alu. | | | | |
| L - 71 | Letpadaung | Dyke | Rhyolite | | ++ | +++ | o | | | Reddish brown colored brecciated rhyolite. |
| 72 | " | Extrusive | Biotite porphyry | + | ++ | +++ | | | | Gray colored pinkish spotted bearing silicified biotite porphyry. Strong alunitization. |
| 73 | " | Ditto | Biotite porphyry | | +++ | +++ | o | | | Brownish gray colored strong alunitized biotite porphyry |
| 74 | " | Ditto | Biotite porphyry | + | ++ | ++ | | | | Pale gray colored fine compact silicified rhyolite with hematite boxwork. |
| 75 | " | Ditto | Biotite porphyry | | ++ | ++ | | | | Ditto |
| 76 | " | Ditto | Biotite porphyry | | | | | | | Brown colored altered biotite porphyry. |
| 77 | " | Ditto | Biotite porphyry | | ++ | ++ | | o | | Dark brownish gray colored silicified and brecciated biotite porphyry with hematite boxwork. |
| 78 | " | Ditto | Biotite porphyry | | ++ | +++ | | | | Strong altered biotite porphyry. |
| 79 | " | Ditto | Biotite porphyry | + | + | ++ | o | | | Argillized and alunitized zone. |
| 80 | " | Ditto | Biotite porphyry | + | + | ++ | | | | Ditto |
| 81 | " | Ditto | Biotite porphyry | + | + | ++ | | | | Ditto |
| 82 | " | Ditto | Biotite porphyry | + | + | + | o | | | Pinkish gray colored weak alunitized and silicified biotite porphyry. |
| 83 | " | Ditto | Biotite porphyry | + | + | + | | | | Ditto |
| 84 | " | Ditto | Biotite porphyry | + | ++ | ++ | o | | | Whitish gray colored silicified and alunitized biotite porphyry. |
| 85 | " | Lava | Hornblende biotite porphyry | + | | | o | | | Gray colored weak argillized. Hornblende bioitte porphyry. |
| 86 | " | Extrusive | Biotite porphyry | | + | | | | | Pale brown colored weak silicified biotite porphyry. |

Sheet 14

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| L - 87 | Letpadaung | Extrusive | Biotite porphyry | | ++ | | | | | Brown colored silicified biotite porphyry. |
| T - 1 | Taungzone | Dampala | Fine tuff | | | | | | | Brown colored very fine grained tuff |
| 2 | " | Ditto | Sandstone | | | | | | | Light brown colored medium grained sandstone. |
| 3 | " | Kangon | Tuffaceous sandstone | | | | o | | | Light brown colored weakly foliated tuffaceous sandstone. |
| 4 | " | Magyigon | Acidic tuff | | | | | | | Brown colored massive coarse grained tuff. |
| 5 | " | Ditto | Sandstone | | | | | | | Gray colored medium grained sandstone. |
| 6 | " | Ditto | Hornblende biotite porphyry | | | | | | | Weathered light gray colored hornblende biotite porphyry. |
| 7 | " | Lava | Hornblende biotite porphyry | | | | | | | Brown colored weathered hornblende biotite porphyry. |
| 8 | " | Ditto | Hornblende biotite porphyry | | | | | | | Brown colored weathered hornblende biotite porphyry. |
| 9 | " | Ditto | Hornblende biotite porphyry | + | | | o | | o | Brown colored weathered hornblende biotite porphyry. |
| 10 | " | Magyigon | Acidic tuff | | + | | | | | Gray colored coarse grained tuff. |
| 11 | " | Ditto | Acidic tuff | | + | | | | | Light brown colored coarse grained tuff. Brown colored weathered lapilli tuff. |
| 12 | " | Ditto | Sandstone | | | | | | | Brown colored weathered medium grained sandstone. |
| 13 | " | Lava | Hornblende biotite porphyry | + | | | | | | Weakly limonitized purple gray colored. Hornblende biotite porphyry. |
| 14 | " | Intrusive | Quartz biotite porphyry | + | ++ | | o | o | | Brown colored weathered quartz biotite porphyry with hematite boxwork. |
| 15 | " | Lava | Hornblende biotite porphyry | + | | | o | | | Brownish gray colored weathered hornblende biotite porphyry. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| T - 16 | Taungzone | Kangon | Oolitized tuff | | | | | | | Brown colored oolitized tuff (oolite: 2 - 4 mm) |
| 17 | " | Ditto | Coarse sandstone | | | | o | | | Brown colored coarse grained sandstone (biotite crystal quarts is continued) |
| 18 | " | Lava | Quartz biotite porphyry | + | ++ | | | | | Pale gray colored weakly argillized a quartz biotite porphyry |
| 19 | " | Intrusive | Quartz biotite porphyry | + | ++ | | | | | White massive quartz biotite porphyry with quartz veinlet. |
| 20 | " | Lava | Biotite porphyry | + | + | | | | | Pale whitish gray weathered biotite porphyry. |
| 21 | " | Intrusive | Quartz biotite porphyry | + | ++ | | | | | Partly limonitized white colored quartz biotite porphyry. |
| 22 | " | Magyigon | Silicified tuff | | | | o | | | Gray colored silicified lapilli tuff. |
| 23 | " | Kangon | Fine tuff | | | | o | | | Alteration of gray colored fine grained and medium grained sandstone. |
| 24 | " | Ditto | Sandstone | | | | | | | Gray colored silicified coarse grained sandstone. |
| 25 | " | Ditto | Oolite | | | | o | | | Light brown colored medium grained sandstone. |
| 26 | " | Magyigon | Altered tuff | | | | o | | | Light brown colored medium grained tuff. |
| 27 | " | Ditto | Acidic tuff | | | | | | | Brownish gray bedded fine grained tuff and coarse grained tuff. |
| 28 | " | Ditto | Acidic tuff | | | | o | | | Ditto |
| 29 | " | Lava | Hornblende biotite porphyry | + | | | | | | Brownish white colored hornblende biotite porphyry. |
| 30 | " | Ditto | Hornblende biotite porphyry | + | + | | | | | Brownish white colored quartz biotite porphyry. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| T - 31 | Taungzone | Kangon | Fine tuff | | | | | | | Light gray colored thin bedded fine grained tuff with limonite stain. |
| 32 | " | Ditto | Tuffaceous sandstone | | | | o | | | White colored fine grained tuff with fragments of shale lense. |
| 33 | " | Intrusive | Quartz biotite porphyry | + | | | o | o | | Brownish white colored quartz biotite porphyry. |
| 34 | " | Lava | Hornblende biotite porphyry | + | | | | | | Pale brown weathered hornblende biotite porphyry. |
| 35 | " | Magyigon | Lapilli tuff | | | | o | | | Light gray lapilli tuff. |
| 36 | " | Ditto | Tuff breccia | | | | o | | | Light gray tuff breccia. |
| 37 | " | Ditto | Lapilli tuff | | | | | | | Gray colored lapilli tuff. |
| 38 | " | Ditto | Lapilli tuff | | | | | | | Gray colored silicified lapilli tuff. |
| 39 | " | Lava | Hornblende biotite porphyry | | + | | | | | Silicified hornblende biotite porphyry |
| 40 | " | Intrusive | Quartz biotite porphyry | | | | | | | Brownish white quartz biotite prophyry. |
| 41 | " | Magyigon | Sandstone | + | + | | | | | Gray colored banded sandstone |
| 42 | " | Kangon | Sandstone | | | | o | | | Brownish white colored tuffaceous sandstone. |
| 43 | " | Magyigon | Sandstone | | | | | | | Brown colored fine grained sandstone. |
| 44 | " | Ditto | Sandstone | | | | | | | Brown colored fine grained tuffaceous sandstone. |
| 45 | " | Ditto | Sandstone | | | | | | | Reddish brown colored medium grained sandstone. |
| 46 | " | Ditto | Sandstone | | | | | | | Brown colored sandstone. |
| 47 | " | Ditto | Sandstone | | | | | | | Light brown colored medium grained sandstone. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| T - 48 | Taungzone | Magyigon | Sandstone | | | | | | | Gray colored silicified and chlolitized. |
| 49 | " | Ditto | Altered tuff | | + | | o | | | Grayish colored silicified medium grained tuff breccia. |
| 50 | " | Ditto | Tuff breccia. | | + | | | | | Alteration of white colored fine grained sandstone and gray shale. |
| 51 | " | Intrusive | Quartz biotite porphyry | | +++ | | | | | Brown colores strong silicified quartz biotite porphyry with pyrite dissemination. |
| 52 | " | Ditto | Quartz biotite porphyry | + | ++ | | o | o | | Whitish brown colored quartz biotite porphyry. |
| 53 | " | Ditto | Quartz biotite porphyry | + | ++ | | | | | Argillized white quartz biotite porphyry. |
| 54 | " | Magyigon | Lapilli tuff | | | | o | | | Light brown colored lapilli-tuff. |
| 55 | " | Intrusive | Quartz biotite porphyry | + | ++ | | | | | Brownish white quartz biotite porphyry. |
| 56 | " | Magyigon | Acidic tuff | + | | | | | | Light gray colored medium grained tuff with weak bedding. |
| 57 | " | Ditto | Acidic tuff | + | | | | | | Grayish white massive medium grained tuff. |
| 58 | " | Ditto | Acidic tuff | + | ++ | | | | | Gray colored massive coarse grained tuff. |
| 59 | " | Lava | Hornblende biotite porphyry | | ++ | | | | | Gray colored silicified hornblende biotite porphyry. |
| 60 | " | Magyigon | Lapilli tuff | + | | | | | | Brown colored limonitized lapilli-tuff. |
| 61 | " | Ditto | Tuff breccia | | | | | | | Brown colored coarse grained tuff and tuff breccia. |
| 62 | " | Ditto | Acidic tuff | | ++ | | | | | Alternated rock of light gray colored very fine grained tuff and medium grained tuff. |
| 63 | " | Lava | Hornblende biotite porphyry | + | + | | | | | Silicified brecciated hornblende biotite porphyry. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| T - 64 | Taungzone | Magyigon | Acidic tuff | + | + | | | | | Brown colored weathered medium grained tuff. |
| 65 | " | Intrusive | Quartz biotite porphyry | + | ++ | | | | | Light gray quartz biotite porphyry (in the tuff-breccia). |
| Km - 1 | Kyaukmyet | Extrusive | Rhyolite | | + | | o | | | Grayish colored siliceous rhyolite with fragment. |
| 2 | " | Magyigon | Fine tuff | + | | | o | | | Grayish white silicified and weathered acidic fine tuff. |
| 3 | " | Extrusive | Rhyolite | | ++ | | o | | | White colored silicified and weathered rhyolite with quartz fragment. |
| 4 | " | Ditto | Rhyolite | | ++ | | | | | White colored silicified rhyolite with banded texture. |
| 5 | " | Ditto | Rhyolite | | ++ | | o | | | Whitish gray colored rhyolite with pyrite, quartz veinlet. |
| 6 | " | Ditto | Rhyolite | | ++ | | o | | | White reddish gray spotted altered rhyolite |
| 7 | " | Ditto | Rhyolite | | ++ | | | o | | Gray compact rhyolite partly brecciated hematitized. |
| 8 | " | Ditto | Rhyolite | | ++ | | o | | | White colored spherulitic rhyolite. |
| 9 | " | Ditto | Rhyolite | | ++ | | | | | White colored silicified autobrecciated rhyolite. |
| 10 | " | Ditto | Rhyolite | ++ | | | | | | Whitish rhyolite weathered, argillized. |
| 11 | " | Magyigon | Sandstone | | ++ | | o | | | Yellowish white weathered, medium grained tuffaceous sandstone. |
| 12 | " | Ditto | Sandstone | | +++ | | o | | | Gray colored strong silicified mudstone with quartz small druse. |
| 13 | " | Ditto | Sandstone | | | | o | o | | Brownish gray colored silicified sandstone. |

| Sample No. | Location | Formation | Rock Name | Alteration | | | Thin Section | Polished Section | Chemical Analysis | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Argi. | Sili. | Alu. | | | | |
| Km - 14 | Kyaukmyet | Extrusive | Rhyolite | | | | | | | Whitish gray colored silicified rhyolite. |
| 15 | " | Ditto | Rhyolite | | | | o | | | Pale violet silicified rhyolite. |
| 16 | " | Ditto | Rhyolite | | | | | | | Reddish gray silicified rhyolite. |
| 17 | " | Ditto | Rhyolite | | | | o | | | Grayish groundmass pyritized plagio-rhyolite. |
| 18 | " | Ditto | Rhyolite | | | | | | | Reddish colored silicified and weathered brecciated rhyolite. |
| 19 | " | Magyigon | Tuff breccia | | ++ | | | | | Whitish weathered and silicified tuff breccia |
| 20 | " | Ditto | Tuff breccia | | | | | | | Reddish gray colored silicified tuff breccia. |
| 21 | " | Extrusive | Rhyolite | | | | | | | Grayish white weathered plagio-rhyolite. |
| 22 | " | Magyigon | Sandstone | | | | o | | | White gray colored banding siliceous fine grained sandstone. |
| 23 | " | Extrusive | Rhyolite | | | | | | | Weathered white colored compact rhyolite. |
| 24 | " | Ditto | Rhyolite | | +++ | | o | | | White gray colored banding fine silicified sandstone. |
| 25 | " | Ditto | Rhyolite | | | | | | | Gray colored massive plagio-rhyolite. |
| 26 | " | Ditto | Rhyolite | | | | | | | Pale reddish brown weathered plagio-rhyolite. |
| 27 | " | Magyigon | Fine tuff | | | | | | | Whitish gray fine grained silicified tuff. |
| 28 | " | Ditto | Fine tuff | | | | | | | Dark gray colored strongly silicified fine tuff. |

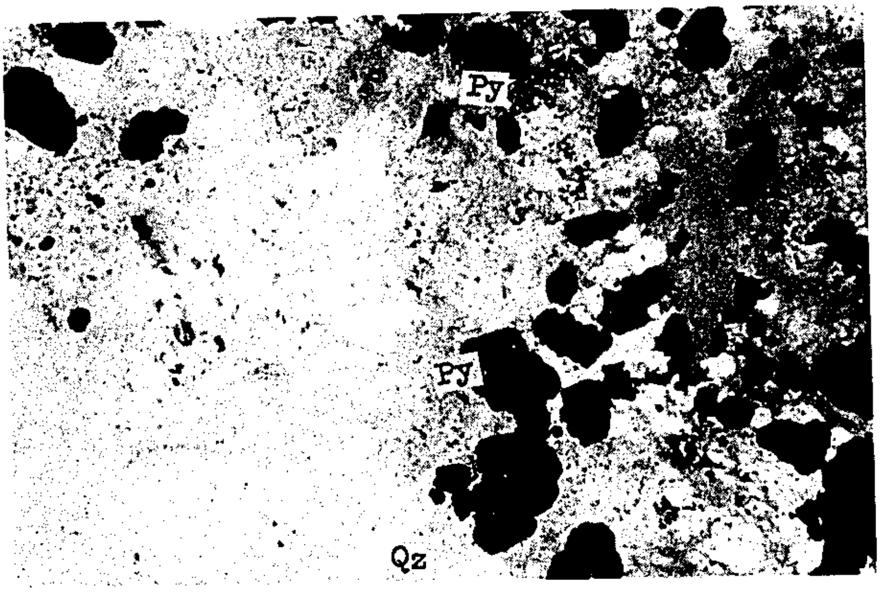
Table I-8 Microphotographs

List of Microphotographs No. 1

| No. | Sample No. | Rock Name | Location | Thin section | Polished section |
|---|---|---|---|---|---|
| 1 | DDH 2-2(30.0) | Vitric Lithic Tuff | Sabedaung | o | |
| 2 | DDH 6-3(72.4) | Altered Rhyolite | " | o | |
| 3 | DDH 6-4(89.7) | " | " | o | |
| 4 | DDH 6-5(110.4) | " | " | o | |
| 5 | DDH 6-6(130.8) | | " | o | |
| 6 | Km 1 | Silicified Rhyolite | Kyaukmyet | o | |
| 7 | Km 3 | " | " | o | |
| 8 | Km 6 | Shale and Sandstone | " | o | |
| 9 | Km 8 | Rhyolite | " | o | |
| 10 | Km 11 | Quartzose Sandstone | " | o | |
| 11 | Km 12 | Silicified rock | " | o | |
| 12 | Km 13 | Silicified Sandstone | " | o | |
| 13 | Km 22 | Tuff | " | o | |
| 14 | Km 27 | Silicified fine Tufff ff | " | o | |
| 15 | Km 28 | Silicified Tuff | " | o | |
| 16 | T - 6 | Hornblende Biotite Prophyry | Taungzone | o | |
| 17 | T - 15 | Hornblende Porphyry | " | o | |
| 18 | T - 22 | Silicified Tuff | " | o | |
| 19 | T - 23 | Silicified Tuffaceous Sandstone | " | o | |
| 20 | T - 25 | Oolite | " | o | |
| 21 | T - 26 | Altered Tuff | " | o | |
| 22 | T - 31 | Fine Tuff | " | o | |
| 23 | T - 32 | Tuffaceous Sandstone | " | o | |

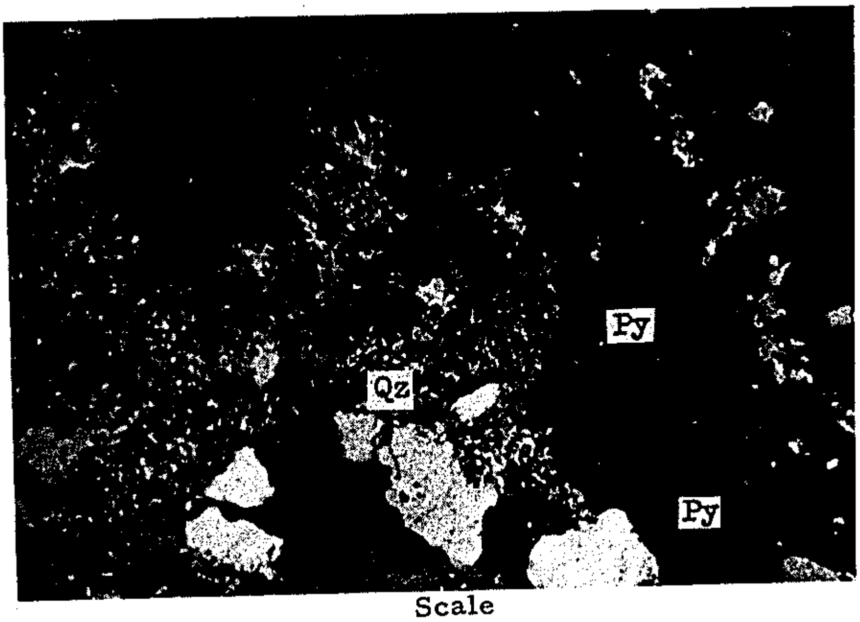
No. 2

| No. | Sample No. | Rock Name | Location | Thin section | Polished section |
|---|---|---|---|---|---|
| 24 | T - 49 | Altered Tuff | Taungzone | o | |
| 25 | DDH 5 (33.0) | Copper Ore | Sabedaung | | o |
| 26 | DDH 5 (70.0) | " | " | | o |
| 28 | DDH 5 (107.0) | " | " | | o |
| 29 | DDH 2 (127.0) | " | " | | o |
| 30 | DDH 8 (129.0) | " | " | | o |
| 31 | Floatation test No. 1 | Concentration | " | | o |
| 32 | " | Tailing | " | | o |
| 33 | T - 28 | Biotite Rhyolitic Tuff | Taungzone | | o |
| 34 | T - 35 | Altered Lapilli Tuff | " | | o |




No. 1
Sample No. DDH. 2-2
(30.0m)
Rock name :
Vitric - Lithic Tuff

Open nicol




Crossed nicols

Qz : Quartz
Py : Pyrite

Scale

1mm

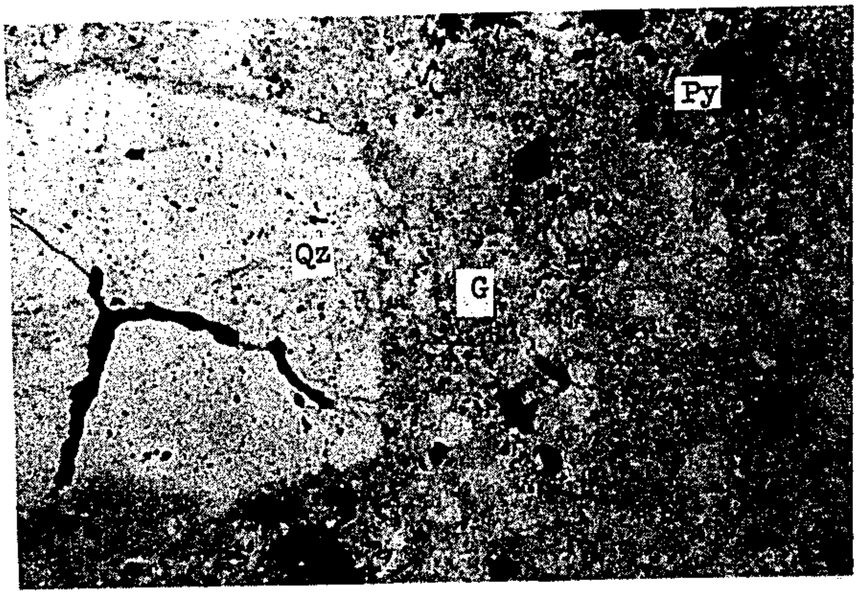
Vitric-lithic tuff (altered)

Crystal fragments : Quartz, 0.2-0.4 mm, a small quantity as corroded forms ; plagioclase is completely altered to sericite like minerals, zircon, a small quantity as fine grains.

Rock fragments : Subangular patches of rhyolite or silicified rocks are abundant.

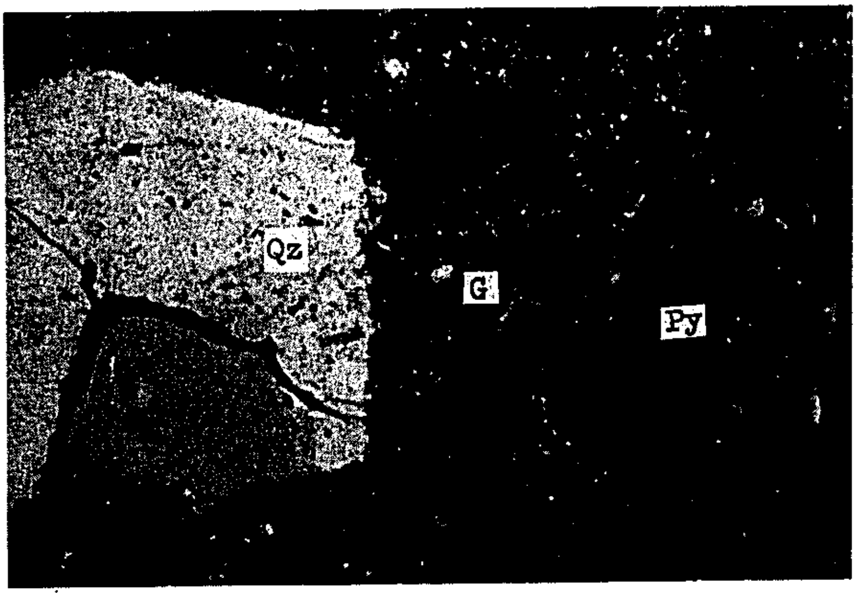
Vitric fragments : Glass patches are common, most of them altered to sericite, zeolite and secondary silica minerals.

Alteration : A fine scaly or fibrous sericite occurs commonly in glass groundmass and in marginal part of quartz phenocrysts and rock fragments. Zeolites are fibrous or radiating in forms, and occur in groundmass. Pyrite is common as fine grains and aggregates in forms. Silicification is also common, quartz aggregates having flamboidal extinction are remarkable.




No. 2
Sample No. DDH 6-3
72.4 m
Rock Name:
Altered Rhyolite

Open nicol




Crossed nicols.

Q2 : Quartz
Py : Pyrite
G : Glass

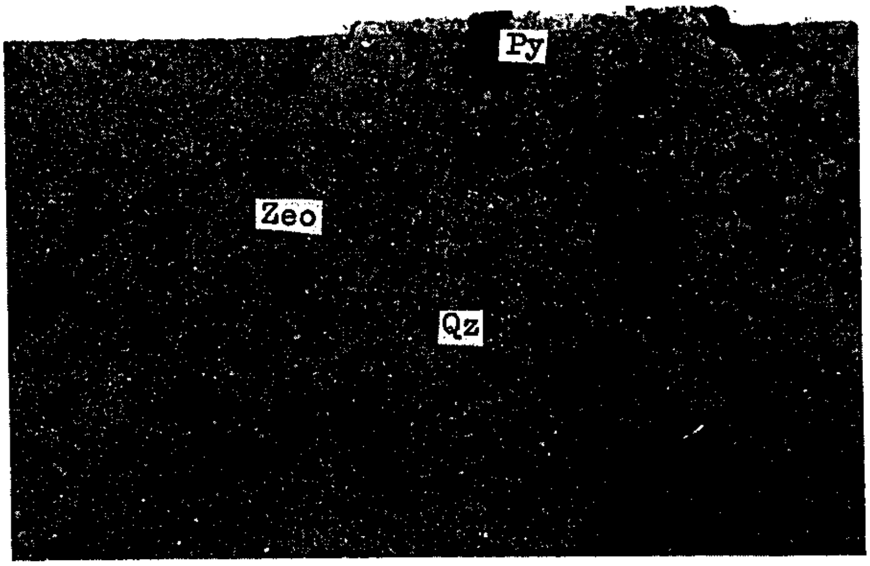
Scale
0 0.5 1mm

**Altered rhyolite**

**Phenocryst : Quartz (0.2-0.6mm) is common as subhedral or corroded forms, and in crystals contain often gas inclusions. Plagioclase is completely altered. Zircon and apatite of accessary mineral show a small quantity as fine grains.**

**Groundmass : Glassy texture (completely altered)**

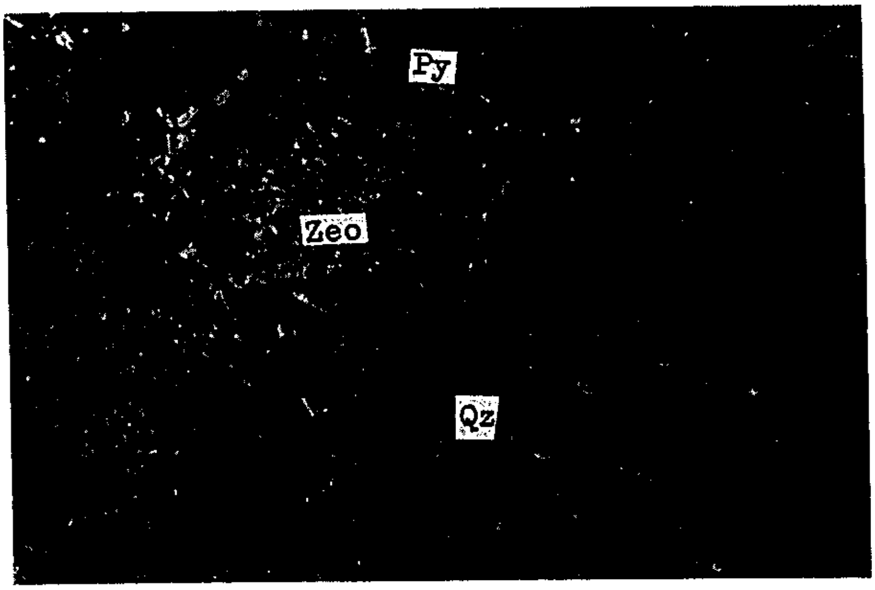
**Alteration : Zeolites showing fibrous or fine radiating forms are dominant, occur in glassy groundmass. Sericitization is also common. Silicification is dominant, fine grained secondary quartz occur abundantly in groundmass. Pyrite is common as fine grained forms. Pyrite-sphalerite vein (3-5 mm in width) is visible.**




No. 3
Sample No. DDH 6-4
(89.7m)

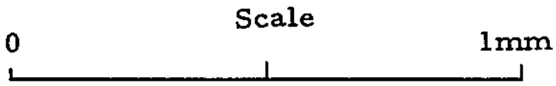
Rock Name : Altered Rhyolite

Open nicol




Crossed nicols

Zeo : Zeolite
Py : Pyrite
Qz : Quartz



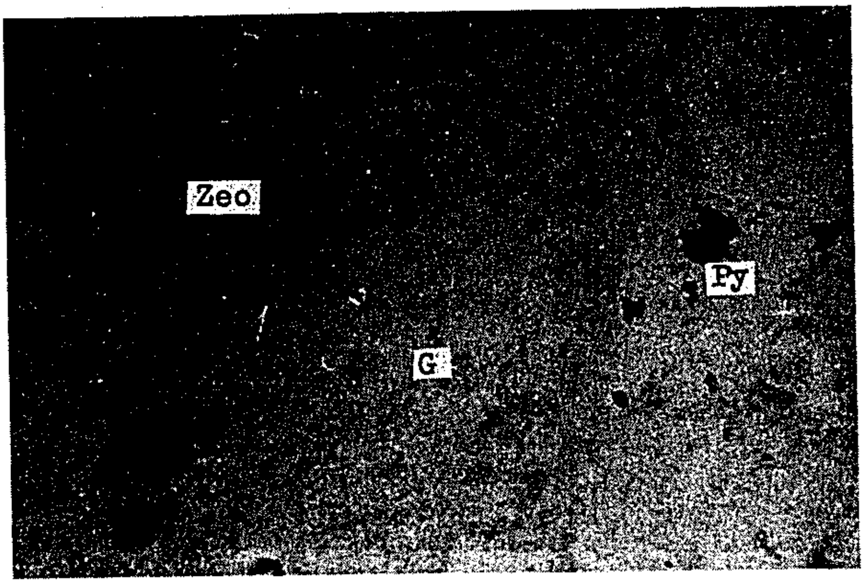

**Altered rhyoite**

Phenocryst : Quartz (0.1-0.4 mm) is common as subhedral or corroded forms, and in crystals contain often gas inclusions. Plagioclase is not recognizable (alteration). Zircon as idiomorphic fine grains occurs rarely in quartz crystal.

Groundmass : Glassy texture (completely alteration)

Alteration : Zeolites showing radiating or fibrous forms are very remarkable. A fine scaly sericite is common. Silicification and pyritization are also common.

No. 4
Sample No. DDH 6-5
(110.4m)
Rock name : Altered Rhyolite




Open nicol


Crossed nicols

Zeo : Zeolite
G : Glass
Py : Pyrite

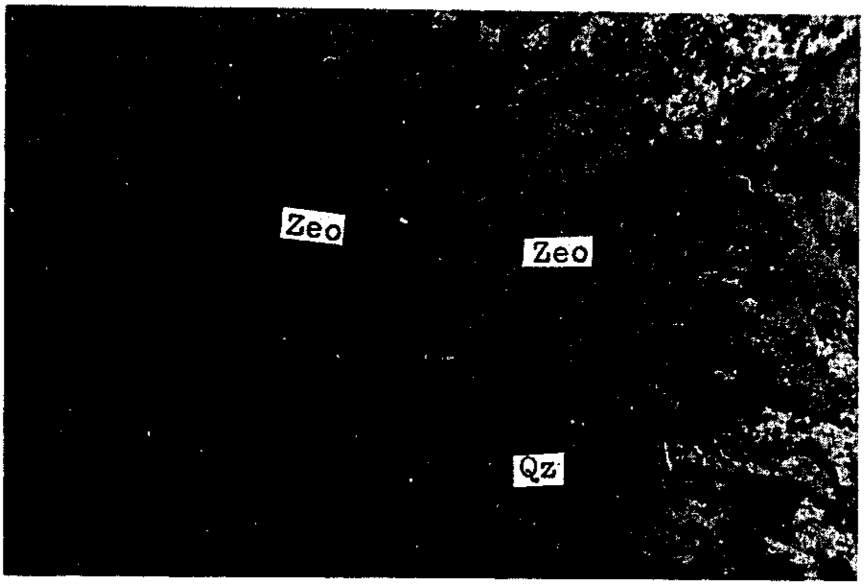
Scale
1mm

Altered rhyolite

Phenocryst : Quartz, 0.2 mm, a small quantity as corroded forms ; plagioclase is not recognizable (alteration).

Groundmass : Glassy texture (completely alteration)

Alteration : Zeolites showing fibrous and radiating forms are very remarkable, and occur abundantly in glassy groundmass. Sericite is common and a fine scaly in forms. Silicification and pyritization are dominent. Quartz veinlets (0.5-1.0 mm) and aggregates having flamboidal extinction are abundant.

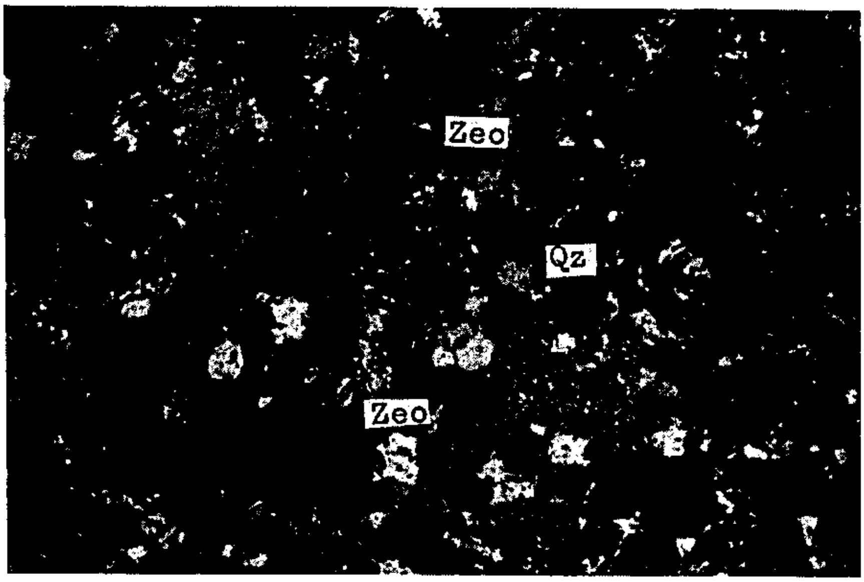



No. 5

Sample No. DDH6-6, 130.8m

Rock Name: Altered Rhyolite

Open nicol




Crossed nicols

Zeo : Zeolite

Qz : Quartz

Scale

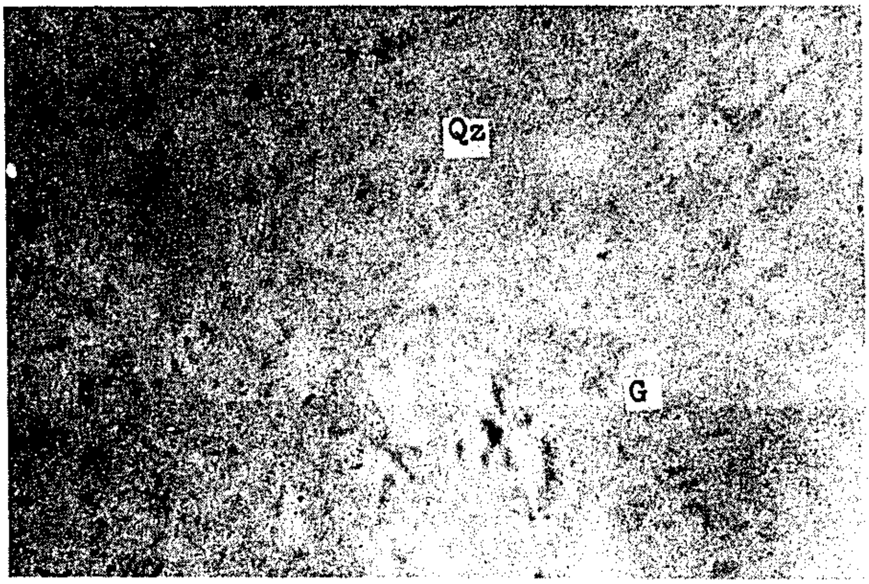
0 1mm

Altered rhyolite

Phenocryst : Most of rock is strongly altered (expressly silicified). Essential phenocryst quartz and plagioclase are not recognizable. Idiomorphic zircon grains (0.3 mm) contain often a small quantity.

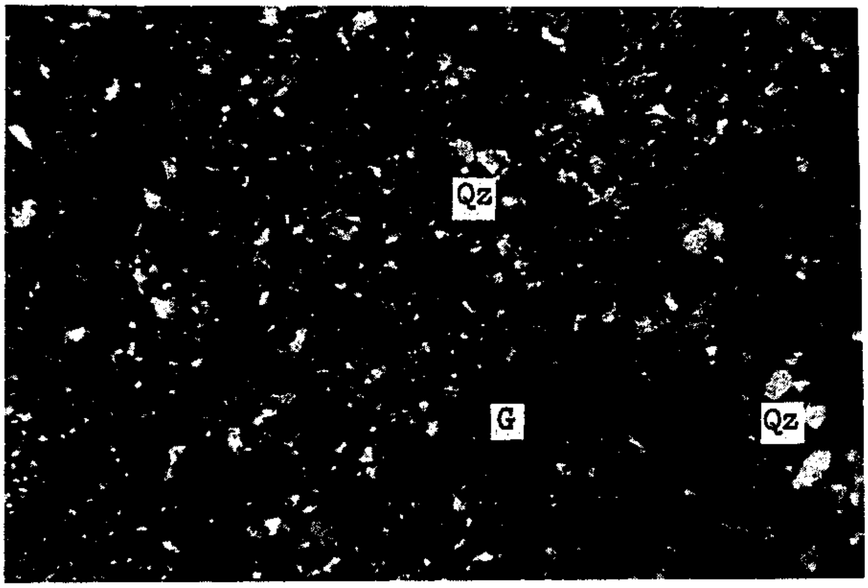
Groundmass : Glassy texture (completely alteration)

Alteration : Zeolites showing radiating and fibrous forms are very remarkable. Silicification is also dominant, aggregates of fine grained quartz occur abundantly in groundmass. Sericite is common, as a fine scaly in forms.




No. 6
Sample No. Km 1
Rock Name : Silicified Biotite Phyolite

Open nicol




Crossed nicols

Qz : Quartz
G : Glass

Scale
1mm

Phenocryst minerals are recognized as follows ; quartz : 0.2-0.3 mm, a small quantity as corroded forms ; plagioclase (albite) : 0.2 mm, rarely as small fragment ; biotite : a small quantity as flake fragment ; accessary minerals : titanite and zircon, both are idiomorphic fine grains.

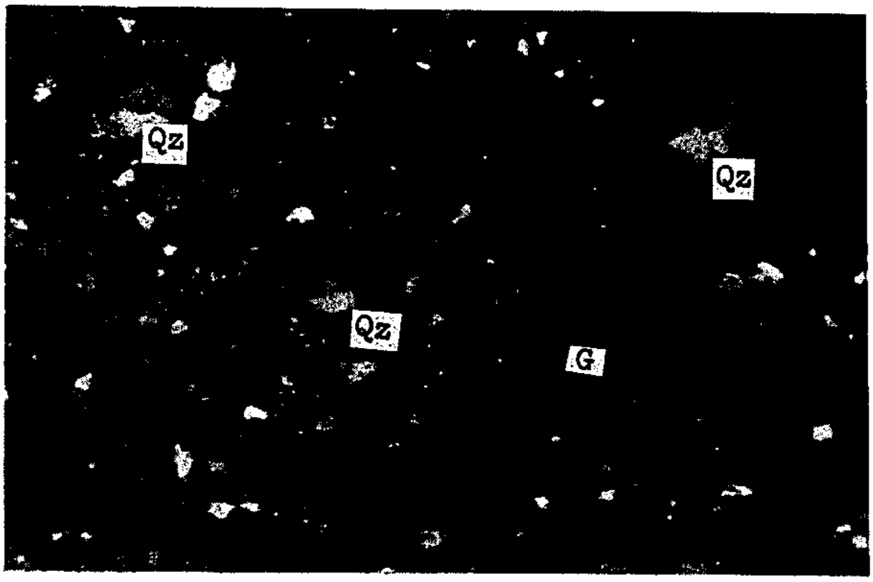
Groundmass show glassy texture and strongly silisified. Aggregated quartz grains, and altered minerals such as opaline silica, sericite and montomorillonite like clay occurs commonly in groundmass.

No. 7

Sample No. Km3

Rock Name : Silicified Rhylite

Crossed nicols




Zq : Quartz

Qz : Glass

Scale

1mm

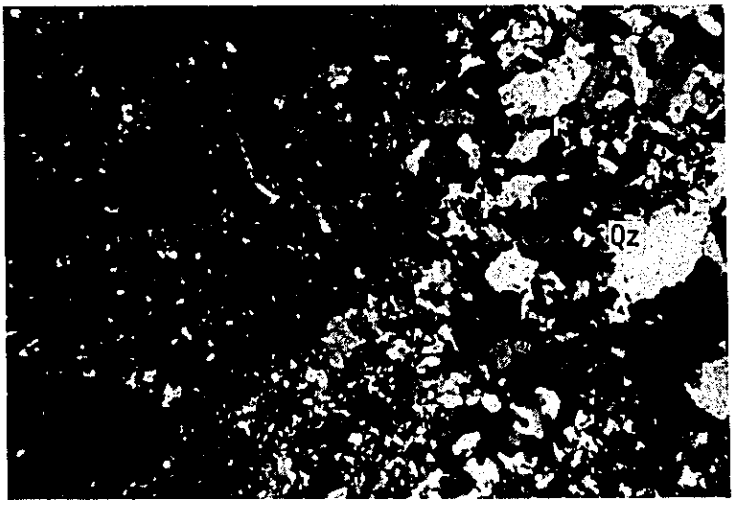
**Silicified rhyolite**

Most of rock is strongly silicified. Silicification showing aggregation of fine grained secondary silica minerals ar~ dominant, and their crystals occur in perpatic groundmass with glassy texture. Essential phenocryst minerals are not recognizable. Quartz veinlets (0.5-1.0 mm) having flamboidal extinction are remarkable. Small flake fragments of biotite and montomorillonite like clay minerals occurs often in vitreous cavities.

No. 8
Sample No. Km6

Rock Name :
Shale and Sandstone


Open nicol




Crossed nicols

Qz : Quartz

Hem : Hematite

Scale
0.5 1mm

This rock is composed two different rocks. One is composed of fine grained fgagmental quartz and glass with subordinate a mount of limestone, calcite and sericite. Another is composed of same coarse grained materials. But strong silicification is remarkable. Thus precise petrography of the original rocks is impossible. In hand specimen, shale and sandstone are mixed heterogeneously.

No. 9
Sample No. Km8
Rock Name : Rhyolite


Open nicol


Crossed nicols
Qz : Quartz

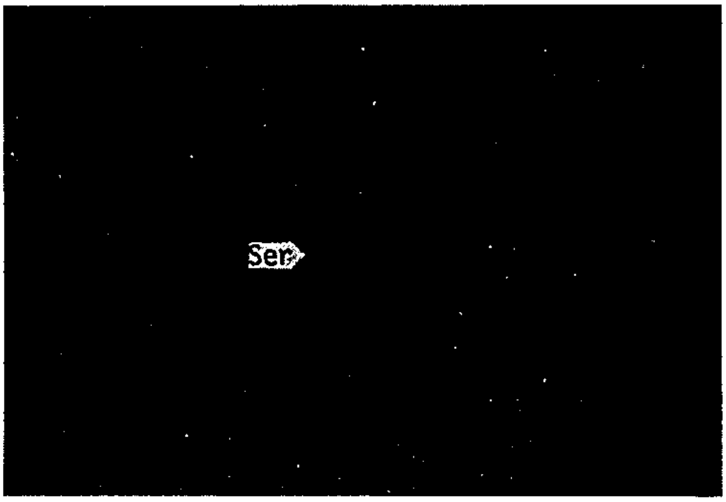
Scale
0.5 1mm

Spheluritic texture is characteristic. Sphelurites are pale yellowish brown and are probably composed of opaline silica. Matrix part is composed of crystallized quartz and small amounts of clay minerals. Silicification is distinctive.

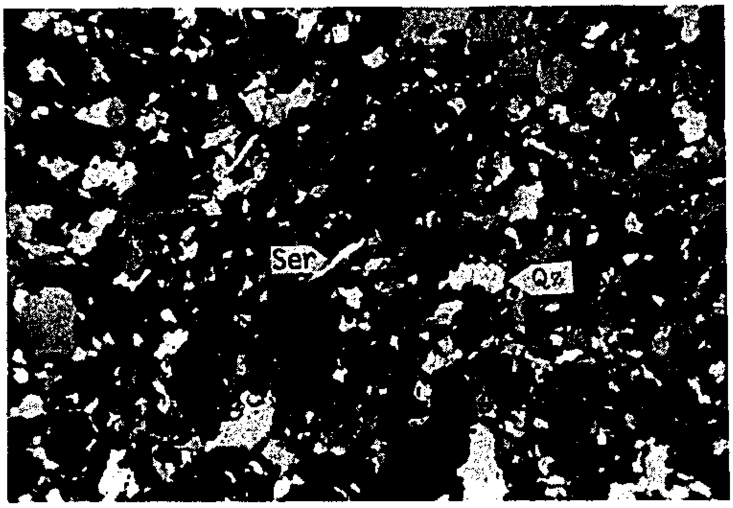
No. 10

Sample No. Km 11

Rock Name :
Quartzose Sandstone




Open nicol




Crossed nicols

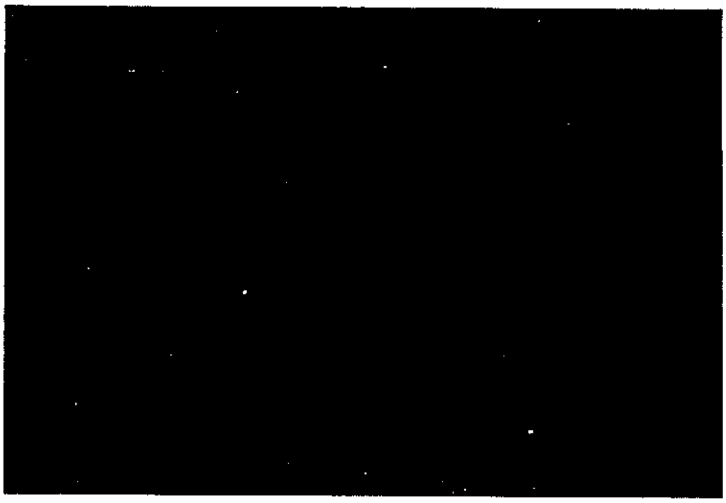
Ser : Sericite

Qz : Quartz

Scale
0.5 1mm

The rock is composed of fragmental quartz, small crystallized quartz with subordinate amounts of sericite, clay minerals and ore. Silicification is remarkable, thus original constituents and texture are uncertain.

No. 11
Sample No. Km 12
Rock Name: Silicified Rock



Open nicol


Crossed nicols

Qz : Quartz

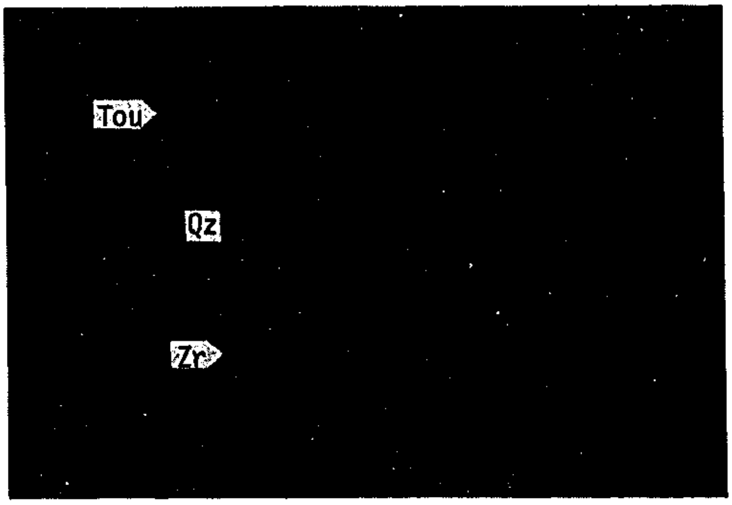
Scale
0.5 1mm

The rock is composed of small crystallized quartz. Estimation of original rock is impossible because of its high silicification.

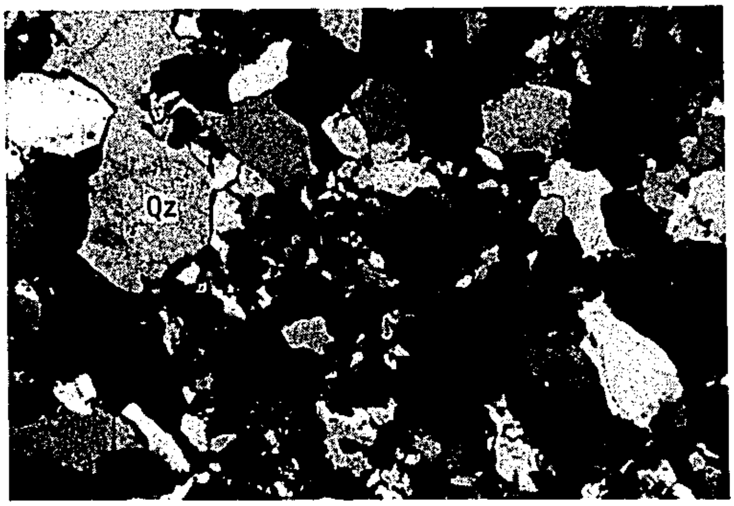
No. 12

Sample No. Km 13

Rock Name :
Silicified Sandstone




Open nicol




Crossed nicols

Tou : Tourmaline

Qz : Quartz

Zr : Zircon

Scale

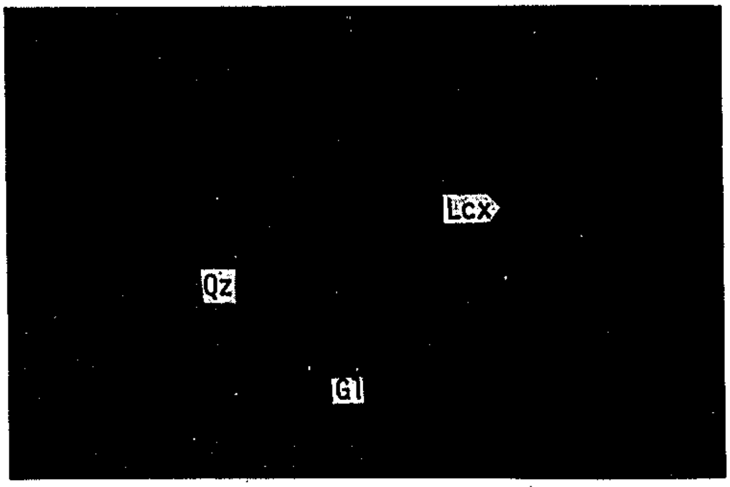
0.5 1mm

The rock is composed of fragmental quartz and small crystalized equigranular quartz. Sericite, chlorite and ore are the secondary minerals. Fragmental and rounded zircon and tourmaline which represent detrital origin are rarely found. Because of strong silicification, determination of name and constituents of original rocks are uncertain.

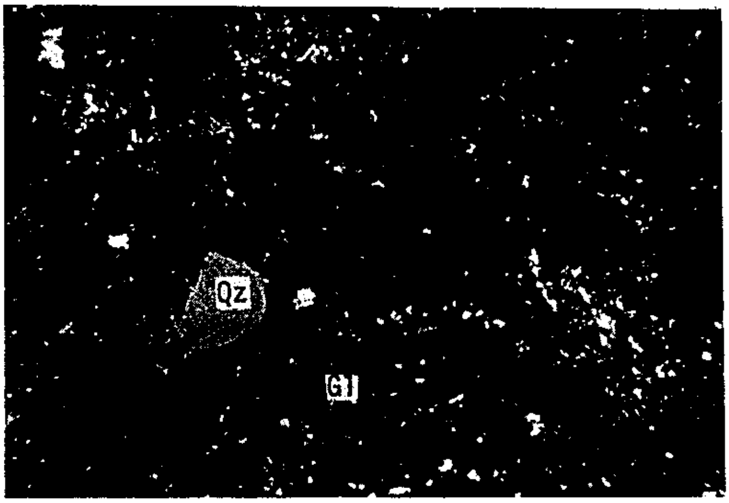
No. 13

Sample No. Km 22

Rock Name : Tuff




Open nicol




Crossed nicols

Qz : Quartz

Lcx : Leucoxene

Gl : Glass

Scale

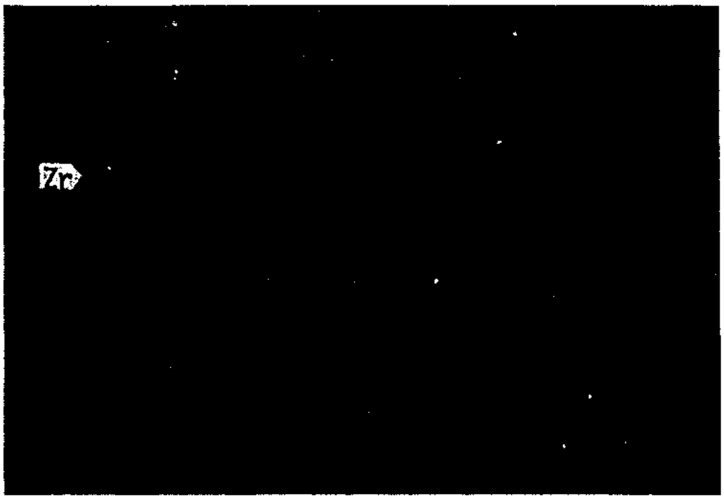
0 0.5 1mm

The rock is composed of alternation of fine and coarse tuff in hand specimen. Coarse part is rich in phenocrystic fragmental quartz and pumiceous material (devitrified glass) which is altered to clay minerals. Matrix of fine part and coarse part is similar in composition with each other and composed of fine quartz and clay minerals. Leucoxene and iron ores are accessories. Weakly devitrified glass.

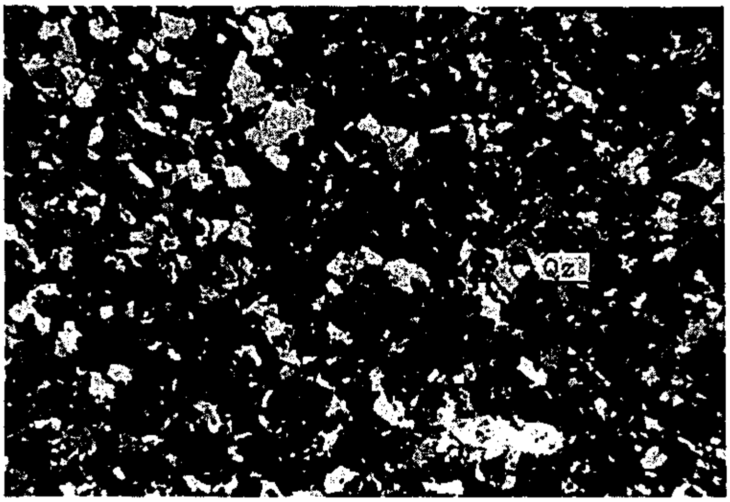
No. 14

Sample No. Km27

Rock Name:
Silicified fine Tuff




Open nicol




Crossed nicols

Zr : Zircon

Qz : Quartz

Scale

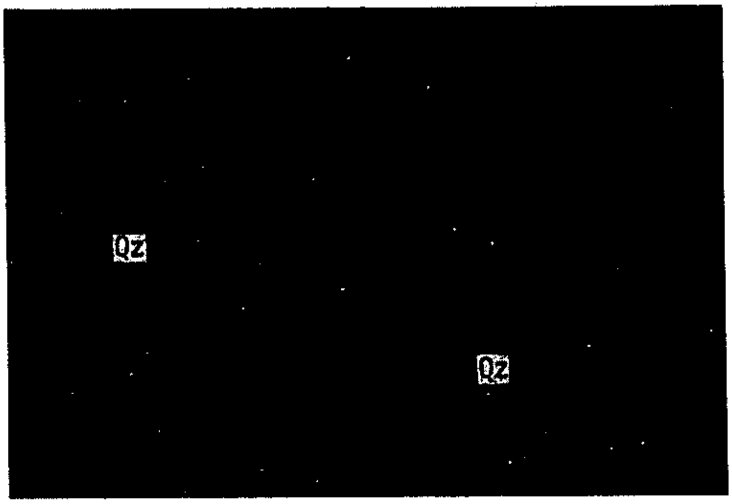
0 0.5 1mm

Almost all of constituents are crystallized quartz. Clay minerals, ore and detrital zircon (subangular) are accessories. Because of its strong silicification, determination of original rock name is impossible.

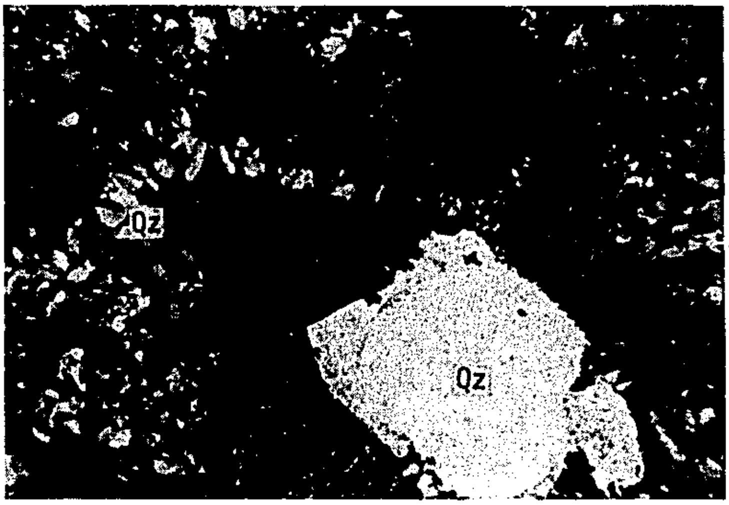
No. 15

Sample No. Km28

Rock Name :
Silicified Tuff




Open nicol




Crossed nicols

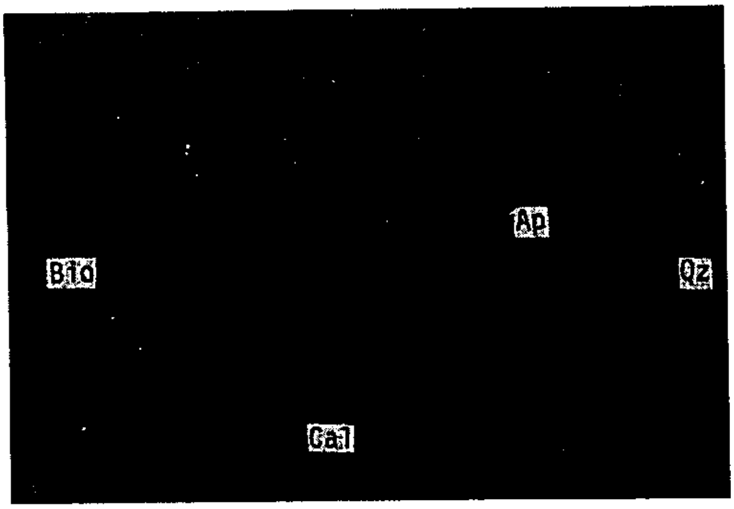
Qz : Quartz

Scale

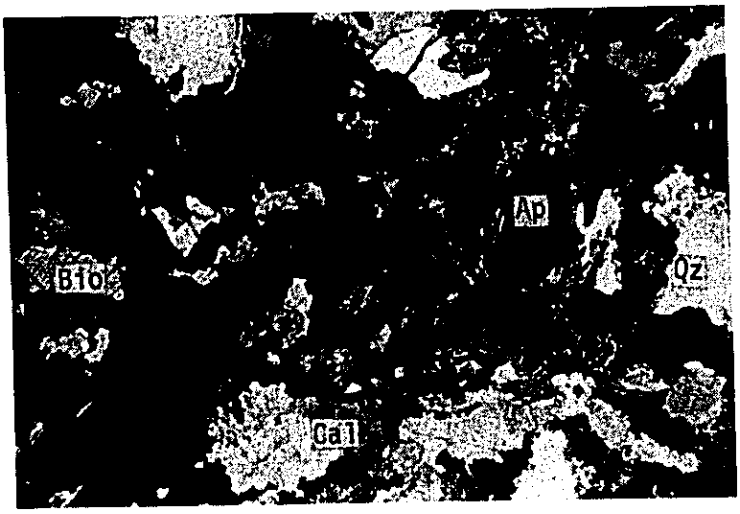
0.5 1mm

It is composed of phenocrystic quartz and large amounts of crystallized small crystals of quartz. Networks of quartz aggregates are dominant. Pseudomorphs of quartz and clay minerals after feldspars are found. Silicification is remarkable, thus original constituents and textures are uncertain. Idiomorphic zircon is rarely observed.

No. 16
Sample No. T 6
Rock Name: Hornblende Biotite Porphyry




Open nicol




Crossed nicols

Scale 0.5 1mm

The rock shows porphyritic texture, and is composed of following minerals.

Phenocryst : Biotite - Idiomorphic to hypidiomorphic flaky, Pleochroism with X=pale yellow, and Z=yellowish brown. It is altered to calcite and chlorite.

Microphenocryst : Quartz - Hypidiomorphic granular.
Apatite - Idiomorphic prismatic crystal.
Uniaxial negative.

Groundmass : Quartz and alkali feldspar, showing graphic intergrowth with each other.
Iron ore.

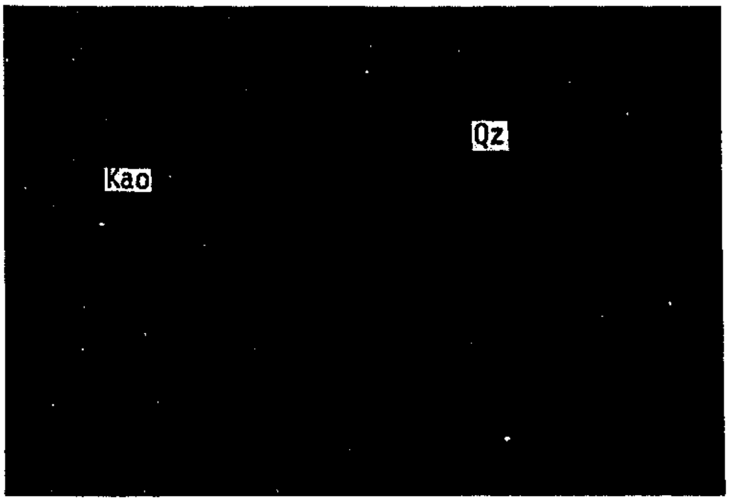
Moreover, large pseudomorphs composed of chlorite, calcite and ore are observed. Sometimes these pseudomorphs show hornblende-like outline, and sometimes feldspars.

Secondary minerals are calcite, chlorite, montmorillonite(?) and ore minerals. Rarely epidote is found.

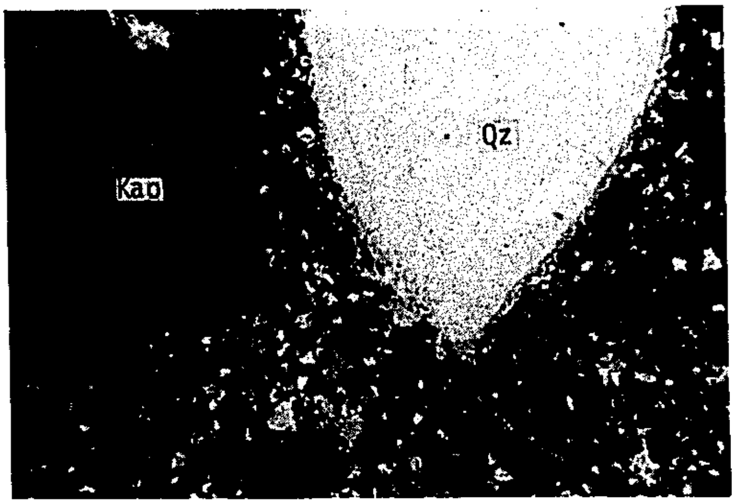
No. 17

Sample No. T-15

Hornblende-porphyry



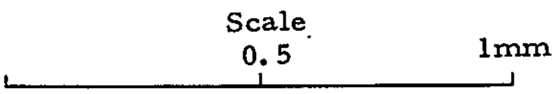

Open nicol




Crossed nicols

Kao : Kaolinite

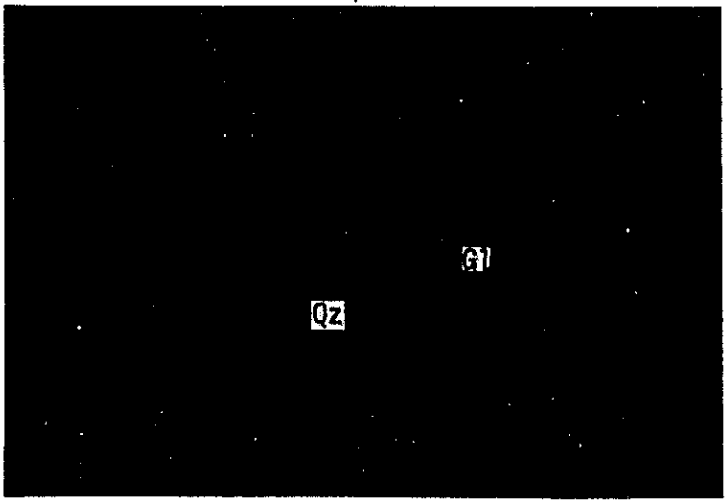
Qz : Quartz



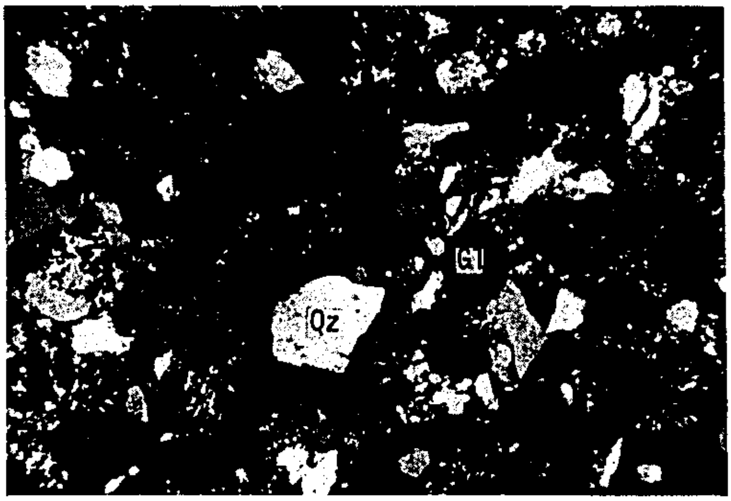

Hornblende-porphyry

The rock shows porphyritic texture. Phenocrystic quartz and pseudomorphs of kaoline(?) after feldspars and Hornblende are recognized. Groundmass is composed of equigranular quartz, clay minerals, and limonite.

No. 18
Sample No. T-22




Open nicol




Crossed nicols

Qz : Quartz
Gl : Glass

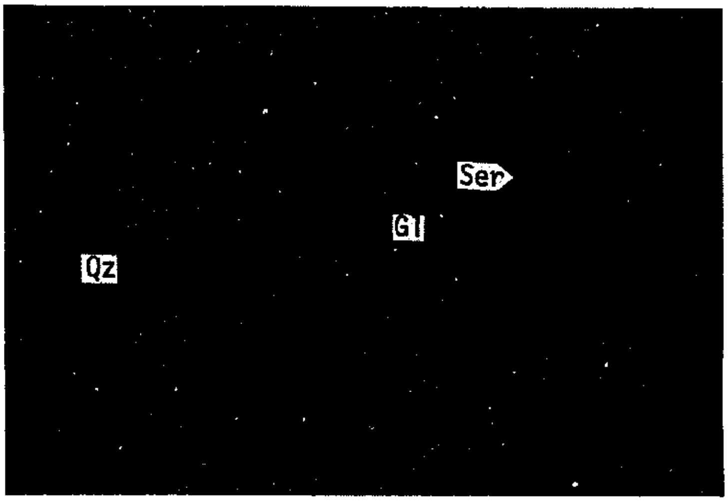
Scale
0.5 1.0mm

**Silicified tuff**

The rock is composed of fragmental quartz and glass, and fine grained matrix of crystallized quartz. Clay minerals are the secondary constituents of devitrified glass. Silicification is distinctive. Thus original constituents and texture are uncertain.

No. 19

Sample No. T-23




Open nicol


Crossed nicols

Ser : Sericite

Gl : Glass

Qz : Quartz

Scale

0.5 1.0mm

Silicified tuffaceous sandstone

It is composed of rather coarse and fragmental quartz and fragmental glass. Matrix is composed of fine grained quartz, small crystallized quartz, and sericite. Small amounts of sericite, clay minerals and ore minerls are secondary minerals. Devitrified glass fragments are dominant. Because of its strong silicification, exact petrography of original rock is impossible.